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THE USE OF PESTICIDES IN SUBURBAN HOMES AND GARDENS AND THEIR IMPACT ON THE AQUATIC ENVIRONMENT

R. V. Rumker, et al

Environmental Protection Agency
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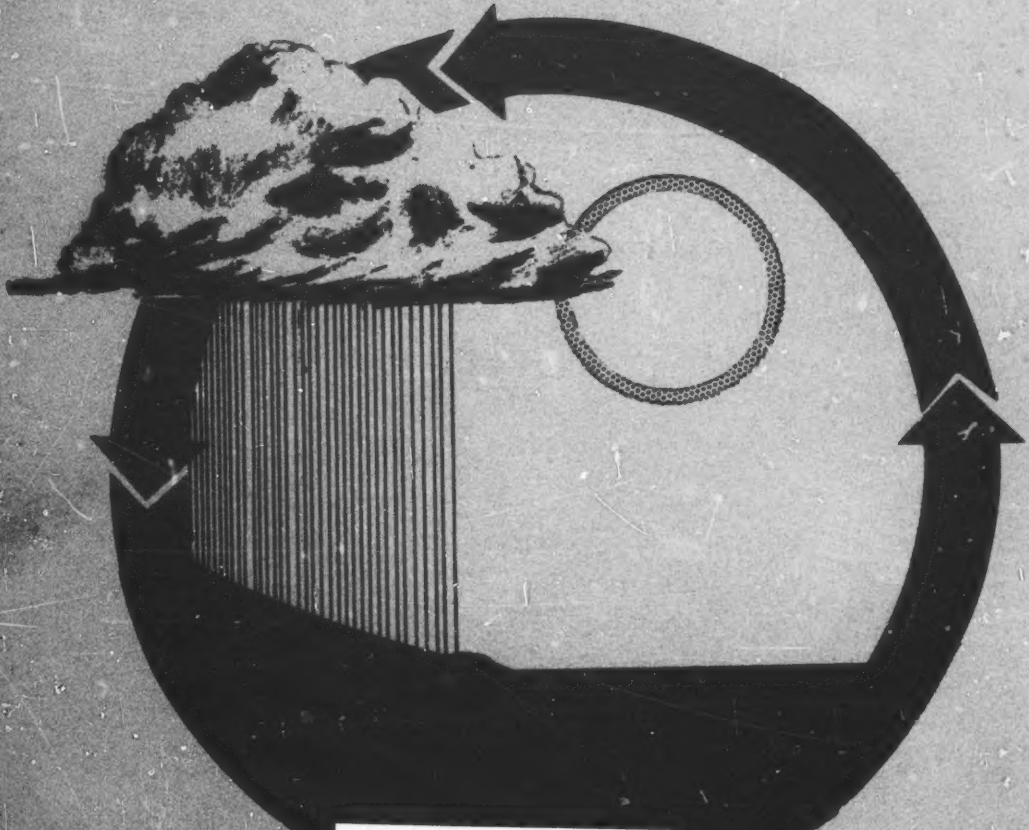

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THE USE OF PESTICIDES IN SUBURBAN HOMES AND GARDENS AND THEIR IMPACT ON THE AQUATIC ENVIRONMENT

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PESTICIDE STUDY SERIES - 2

THE USE OF PESTICIDES IN SUBURBAN HOMES AND GARDENS AND THEIR IMPACT ON THE AQUATIC ENVIRONMENT

This study is the result of
Contract No. 68-01-0119 awarded by the OWP,
as part of the Pesticides Study (Section 5(ℓ)(2) P.L. 91-224)
to Ryckman, Edgerley, Tomlinson and Associates, Inc.

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Applied Technology Division
Rural Wastes Branch

May 1972

EPA Review Notice

This report has been reviewed by the Office of Water Programs of the Environmental Protection Agency and approved for publication. Approval does not signify that the contents necessarily reflect the views and policies of the Environmental Protection Agency, or does mention of trade names or commercial products constitute endorsement or recommendation for use.

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FOREWORD

Among all environmental pollutants, chemical pesticides have aroused special concern. They are widely used throughout the United States on croplands, rangeland, forests, lawns, turf, in and around homes, for protection of structures and stored products, and over entire areas for mosquito control, insect eradication, imported fireant control, and similar area-wide programs. Chemical pesticides include insecticides, fungicides, nematicides, herbicides, rodenticides, defoliants, desiccants, plant growth regulators and similar biologically active compounds. Depending on dosage, many pesticides are toxic to humans, animals and other non-target organisms.

Some environmental aspects of some specific pesticides have been studied, but no overall quantitative description and assessment of the pesticide pollution problem has been made. In compliance with Section 5 (1) (2) of Public Law 91-224, however, the Office of Water Programs of the Environmental Protection Agency has organized and conducted a series of pesticide studies which are intended to provide a comprehensive analysis of the pesticide problem in the United States.

This particular case study was conducted by Ryckman, Edgerley, Tomlinson and Associates, Inc. (RETA) with Dr. R. von Rumker as Sub--contractor and Project Consultant.

Using all available information, this study provides an in-depth evaluation of the impact on the natural environment of pesticides used in the suburban homes and gardens of Philadelphia, Lansing and Dallas.

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This report is the product of six months of intensive, in-depth research and analysis. A large number of people and organizations in the states of Pennsylvania, Michigan, and Texas were contacted, and most of these were very helpful in providing information. Gratitude is extended to the many home owners, garden clubs, the Pennsylvania Horticultural Society, the University Research and Extension Workers, home and garden pesticide manufacturers, distributors and retailers, commercial applicators, city and county officials, doctors, veterinarians, and Congressional leaders who were contacted in the three study areas. While the names of these contributors are too numerous to list individually, their assistance and cooperation was essential to the successful completion of this project.

INTRODUCTION

As part of the pesticide study authorized and required by Section V (ℓ) (2) of Public Law 91-224, the Environmental Protection Agency (EPA) has initiated a series of case studies on the effects of different pesticide uses on the natural environment. Each of these studies is designed to describe and document the movement of pesticides from initial point of use to and into the aquatic environment, to the point of ultimate impact and effect on the ecosystem.

The present study under contract number 68-01-0119 is concerned with the use of pesticides in suburban homes and gardens in three different metropolitan areas, Philadelphia, Pennsylvania; Dallas, Texas; and Lansing, Michigan. The [illegible] describe the following;

This report has the following objectives:

1. to analyze, describe and document quantitatively the use of pesticides in suburban homes and gardens.
2. to evaluate and document quantitatively the direct and indirect impact on the natural environment resulting from pesticide uses, with special emphasis on the movement of pesticides and their possible metabolites and degrada-

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tion products from the initial point of use to and into the aquatic environment, to the point of ultimate effect on the ecosystem;

3. to pinpoint areas of actual or potential environmental damage;
4. to provide a basis for systematic correction of such damage to the natural environment;
5. to describe applicable local and state laws and regulations, and evaluate their effectiveness in preventing environmental damage.

This study was carried out jointly by the contract team of Ryckman, Edgerley, Tomlinson & Associates, Inc. (RETA) of St. Louis, Missouri and R v R Consultants of Shawnee Mission, Kansas. The data, conclusions and recommendations detailed in the Summary Report and Appendices were developed through extensive personal field studies, telephone interviews, questionnaires, and literature surveys.

HOME AND GARDEN PESTICIDE USES

According to the U. S. Tariff Commission, 1,034 billion pounds of active ingredients of pesticides and related products were produced in the United States in 1970. This quantity included 404 million pounds of herbicides, 490 million pounds of insecticides, and 140 million pounds of fungicides. Several different sources report that approximately one-half of this quantity is accounted for by domestic farm uses of pesticides. Literally hundreds of people at the Federal, State, and local level are engaged in collecting information on the use patterns and disposition of these agricultural pesticides by geographical areas, crops, and individual chemicals. Several states have recently installed systems for routine collection and publication of farm pesticide use statistics. Most, if not all, of the public debate and the news media's attention to pesticides has centered on problems associated with their uses in agriculture.

It is truly surprising that, at the same time, almost no attention has been paid to the fate and disposition of the other 500 million pounds of pesticides which constitute the balance between total production and farm use. It is believed that this quantity is made up of pesticides used for industrial purposes, by public agencies, and by homeowners. The relative share of each of these segments is unknown. Exports may also enter into the total balance sheet, but only to the extent of any possible excess of exports over imports. (The above mentioned 1,034 billion pounds total production do not include imports).

The request for "an inventory and description of pesticide uses in the area, including a tabulation of quantities and types of major pesticides used" in the specifications of this contract probably represents the first systematic effort by a government agency to develop quantitative information on non-farm uses of pesticides. It is obvious that such information is much needed for an assessment of the total pesticide problem and its potential for water pollution, especially since non-farm uses of pesticides often result in deposit of higher amounts of pesticides on smaller land areas as compared to farm uses.

The term "pesticide" as used in this report includes insecticides, herbicides, and fungicides. The term "pest" includes insects, mites, weeds, fungus diseases, and similar agents affecting plants, people, structures, etc. "Use of pesticides in suburban homes and gardens" (as set forth in the contract specifications) is defined as pesticide uses by suburban residents, commercial tree and lawn sprayers, golf courses and city, county, and other public agencies. Industrial or residential indoor uses of pesticides in the center cities, for instance, for rodent control, or pesticide uses by professional exterminators are not included in this definition. The "suburban area" for purposes of this study is defined as the total land area carrying single family dwelling units, plus adjacent parks, golf courses, and similar lands.

There is no information in the published literature on the kinds and quantities of pesticides used in suburban homes and gardens, nor on methods on how to obtain such data.

In suburban areas, pesticides are used by homeowners, by commercial tree and lawn sprayers, by golf courses, and by public agencies. Among these user groups, homeowners dispense by far the greatest pesticide quantities. To arrive at meaningful estimates of the kinds and quantities of pesticides used by these groups, especially by homeowners, proved extremely difficult. Homeowners themselves know and remember the products they use only by brand names and/or trade names. They are usually not able to quantify their pesticide uses in terms of pounds, quarts or units of product(s), but only in terms of dollars spent, if at all.

Homeowners very rarely know which pesticide active ingredient(s) they used.

Home and garden pesticide retailers may have a somewhat greater knowledge of the products they offer, but personnel at the retail level rarely know what quantities they actually sell. Retailers often just make shelf or floor space in their stores available to different home and garden pesticide brands. The salesmen representing these brands, or their distributors, regularly restock their particular shelf or floor space with those products which they think will move best at that particular season. These products are billed centrally, and store personnel at the retail level usually do not see this information.

Manufacturers of home and garden pesticides would probably be the best and simplest source of information on the kinds and quantities of the products which they produce and market. However, they operate in a very competitive market and were therefore understandably reluctant to release for eventual publication information on the marketing and distribution of their products.

Thus, the request for quantitative data on suburban pesticide use in the specifications of this contract presented a difficult and complex task. At the same time, it was clear that information on pesticide inputs would be a prerequisite to dealing with the subsequent tasks in the contract. Consequently, a major effort was devoted to collecting this information.

This case study was conducted in three different cities. Philadelphia, Pennsylvania was chosen as a large metropolitan area representative of the Middle Atlantic United States. Dallas, Texas was selected as a large, rapidly growing metropolitan area typical of the Mid-south. Lansing, Michigan was included as representative of a smaller metropolitan area in the upper Midwest.

The main suburban pest problems in the Philadelphia area are weeds and, to a lesser extent, insects and diseases on lawn and turf grasses; scales and a variety of other insects on shade trees and shrubs; insects and diseases on roses and other perennial flowers; and mosquitoes, wasps and hornets which bother people. In the Dallas area, lawn insects are by far the biggest pest problem in suburbia. Insects and diseases on trees and shrubs and lawn weeds are less predominant. In Lansing, Michigan, weeds and insects on lawns are both important; the Dutch elm disease - elm bark beetle complex is still being fought and foliar insects and diseases on roses, ornamental trees and shrubs, as well as mosquitoes, are problems.

In each of the three study cities, we conducted a survey of homeowners, including many personal door-to-door calls. Other sources of information contacted in each city included the State Agricultural Extension Service; Regional, County, and City Planning Departments; City and County Health, Parks and Recreation Departments; commercial tree and lawn spraying companies; and home and garden retail outlets. Several of the major national manufacturers of home and garden pesticides were also contacted.

Tables 1, 2, and 3 summarize the estimated quantities of home and garden pesticides used in Philadelphia, Dallas and Lansing, respectively, broken down by major individual products and user groups. Table 4 gives a summary of the pesticide quantities used in each city, combining all types of uses included in the survey, i.e., homeowners, commercial tree sprayers, golf courses, city departments and area-wide insect control programs. Table 4 also includes the total population, and the number of single family dwelling units in each study area.

The three areas combined have a population of about 5.5 million and comprise 1,244,000 single family dwelling units. There were no correlations between the number of single family residences and the estimated quantities of pesticides used in each area. Climatic, soil and other

TABLE 1

ESTIMATED QUANTITIES OF HOME & GARDEN PESTICIDES USED IN PHILADELPHIA, PA. SUBURBS, 1971
(Lbs. of Active Ingredient)

Pesticides →	Herbicides		Insecticides						
User Group ↓	Phenoxy-type	Other Herbicides	Chlordane	Dicofol	Methoxychlor	Malathion	Dimethoate	Other Insecticides	Fungicides
Homeowners	79,000	10,000	50,000	10,000	(1)	95,000	11,500	32,000	46,000
Commercial Sprayers	negl.	negl.	640	500	1,600	7,000	3,700	14,000	4,200
Golf Courses	(2)	3,600	3,600	(1)	(1)	(1)	(1)	1,000	40,000
City Parks	-	-	-	-	-	100	200	600	-
Mosquito Abatement	-	-	-	-	-	2,300	-	700	-
Totals	79,000	13,600	54,240	10,500	1,600	104,400	15,400	48,300	90,200

(1) Included in "Other Insecticides"
(2) Included in "Other Herbicides"

TABLE 2

ESTIMATED QUANTITIES OF HOME & GARDEN PESTICIDES USED IN DALLAS, TEXAS SUBURBS, 1971
(lbs. of Active Ingredient)

Pesticides →	Herbicides				Insecticides						
User Group ↓	phenoxy-type	dicamba	atrazine	other herbicides	chlordane	dieldrin	carbaryl	malathion	diazinon	other insecticides	fungicides
Homeowners	10,500	3,500	3,500	3,000	35,000	11,000	15,500	57,500	24,000	73,000	20,000
Commercial Sprayers	← negligible →				1,000	2,000	3,000	3,000	4,000	6,000	2,500
Golf Courses	100	(1)	(1)	2,000	3,000	1,000	800	800	1,000	1,000	3,000
City Programs	← negligible →				(2)	(2)	(2)	5,000	2,000	2,500	negl.
Totals	10,600	3,500	3,500	5,000	39,000	14,000	19,300	66,300	31,000	82,500	26,000

(1) Included in "other herbicides"

(2) Included in "other insecticides"

TABLE 3

ESTIMATED QUANTITIES OF HOME & GARDEN PESTICIDES USED IN LANSING/EAST LANSING, MICHIGAN SUBURBS, 1971
(Lbs. of Active Ingredients)

Pesticides ⟶		Insecticides					
User Group ↓	Herbicides^1	Chlordane	methoxychlor	malathion	carbaryl	other insecticides	Fungicides
Homeowners	12,100	3,500	(2)	3,700	1,700	5,600	2,800
Commercial Sprayers	negl.	negl.	3,300	-	800	550	negl.
Golf Courses	500	(2)	negl.	(2)	(2)	1,000	1,000
Mosquito Abatement	-	-	-	-	-	2,500	-
Totals	12,600	3,500	3,300	3,700	2,500	9,650	3,800

(1) Predominantly phenoxy-type products.
(2) Included in "Other Insecticides".

TABLE 4

SUMMARY OF POPULATION, SINGLE FAMILY DWELLINGS AND ESTIMATED QUANTITIES OF HOME AND GARDEN PESTICIDES USED IN THE THREE STUDY AREAS, BY PRODUCTS

Study Area	Popu-lation (000)	Single Family Dwellings	Home and Garden Pesticides Used, 000 Lbs. of Active Ingredients																
			Herbicides					Insecticides											
			Phenoxy	Dicamba	Atrazine	Other Herbicides	All Herbicides	Chlordane	Dieldrin	Dicofol	Methoxychlor	Dimethoate	Carbaryl	Malathion	Diazinon	Other Insecticides	All Insecticides	All Fungicides	All Pesticides
Philadelphia	3,866	879,413	79	(1)	(1)	14	93	54	(2)	11	2	15	(2)	104	(2)	48	234	90	417
Dallas	1,327	307,775	11	4	4	5	24	39	14	(2)	(2)	(2)	19	66	31	82	251	26	301
Lansing	272	56,658	13	(3)	(3)	(3)	13	4	(3)	(2)	3	(3)	3	4	(2)	10	24	4	41
Totals	5,465	1,243,846	103	4	4	19	130	97	14	11	5	15	22	174	31	140	509	120	759

(1) Included in "Other Herbicides"
(2) Included in "Other Insecticides"
(3) Negligible

environmental conditions, as well as many man-made factors, vary a great deal between the three cities. As a result, each area has a distinctly different home and garden pesticide use pattern.

We estimate that a total of slightly over 750,000 pounds of pesticide active ingredients were used in the three study areas combined during the last year. This quantity consists of approximately 130,000 pounds of herbicides, 510,000 pounds of insecticides, and 120,000 pounds of fungicides. Efforts to relate these quantities to the size of the area treated are hampered by the lack of adequate land use data for the study cities. We therefore attempted to quantify pesticide input per surface area, at least for homeowner use. Homeowners alone used an estimated 609,000 pounds of pesticide active ingredients. Assuming that the average lawn and garden area per residence ranges somewhere between 2,000 and 4,000 square feet in size, the average deposit of pesticide active ingredients per acre would be somewhere between 5.3 and 10.6 pounds. While it would not be realistic to define this estimate more closely without additional data, it is obvious that the home and garden use of pesticides deposits high amounts of chemicals per acre. Suburban lawns and gardens probably receive the heaviest applications of pesticides of any land area in the United States.

Of the 510,000 pounds of insecticide active ingredients used (Table 4), we estimate that about 160 to 180,000 pounds were chlorinated hydrocarbons (chlordane, dieldrin, dicofol, and methoxychlor, plus a portion of the materials included under "other insecticides"). This is probably a much smaller quantity of chlorinated hydrocarbons than was used in the area in the past. Reasons for this reduction in the use of persistent insecticides include replacement of DDT by less persistent chemicals in most home and garden products, and discontinuation of its use for control of elm bark beetles, mosquitoes and gypsy moths. In the absence of any prior information on suburban pesticide uses, it is impossible to quantify these statements.

Many suburbanites commented that they wished to reduce their use of pesticides. However, this intention tends to be wiped out by the increasing use of multiple-purpose "convenience" pesticides. Thus, the rate of pesticide use per residence is probably still on the increase, and total consumption is further increased by the continuous construction of additional single family residences.

Home and garden pesticides are offered in an almost bewildering variety of different brands, formulations, package sizes, and application options. Products found in the study areas contain some 50 to 60 different chemical active ingredients, formulated alone or in all kinds of combinations. The chief purpose of combining active ingredients is to offer control of a wider variety of insects, weeds or diseases, or multiple effectiveness, i.e., control of insects, weeds and/or diseases, with or without plant nutrients added.

The labeling of these products makes it almost impossible for the layman to identify them by the active ingredients which they contain. On the other hand, Federal and State agencies issuing research results and recommendations on the use of these pesticides refer to them by their common names or chemical names. However, the lay gardener cannot relate these names to the colorfully advertised, packaged and labeled products offered for sale. Thus, he has practically no unbiased source of information on their effectiveness, persistence or other properties. For instance, a person wishing to determine if he really needs a two-, three-, or four-way combination product has no unbiased way of finding out.

Dry granular formulations of home and garden pesticides with or without plant nutrients are increasing in popularity. These products are applied by fertilizer spreaders. Liquid concentrates or wettable powders are applied by hose-end or tank sprayers. Dusts and aerosol products are usually dispensed directly from the container. Commercial operators and public agencies employ hydraulic spraying equipment.

Home and garden pesticide formulations and application techniques vary in their propensity to cause environmental pollution. The use of dry granular products applied by spreaders, and the use of sprayable products by low-pressure hose-end or small tank sprayers have a relatively low pollution potential. Likewise, aerosols and dusts dispensed from small containers do not have a high pollution propensity. Overuse of these latter products is unlikely because of their relatively high cost. On the other hand, the use of liquid insecticides on lawns, and the use of pesticides on trees growing over pavement where run-off during or after application would go directly into sewer systems are much more liable to cause pollution by way of transport of pesticide particles or residues away from the site of application.

Of 525 respondents to a survey conducted uniformly in each of the three cities, 92.5 percent reported using pesticides. Eighty-four percent reported doing so without reservations, whereas 8.5 percent indicated concern about possible side effects. Seven and five tenths percent of the respondents reported using no pesticides at all. Concerning possible adverse effects on the environment, 43 percent of all respondents replied specifically that they had not observed any. Fifty-three and five tenths percent made no reply to the question, whereas 3.5 percent reported believing that birds, bees, etc. were diminishing and/or that pets became sick from the use of pesticides around the house and yard. There were no reports of adverse effects on human health associated with the use of home and garden pesticides.

APPLICATION TECHNIQUES OF PESTICIDES AND THEIR ROUTE INTO THE WATER ENVIRONMENT

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Included in this section is a discussion of the use by homeowners and professional applicators of different pesticide formulations and modes of application. Pertinent factors are users' understanding and observance of directions, mixing and calibrating procedures. Attention is also given to the various means by which pesticides get from this original point of application into the aquatic environment. The routes discussed include run-off movement in ground water, atmospheric processes, disposal of pesticides and pesticide containers, and accidental spills.

Ranking of Transport Mechanisms

Liquid based pesticides have a high propensity to enter run-off as long as they are in an emulsified state. The time of mobility is determined by the emulsion used to disperse the pesticide in the carrier water but is believed to be on the order of 3 to 5 days. The emulsifiers evaporate after application, leaving the pesticide behind on the target. The pesticide is adsorbed on the surface of organic material present in the target area and thus becomes anchored at the target area. However, if rainfall occurs after application but before the breaking of the emulsion by evaporation or adsorption, or both, the rainwater may combine with the pesticide emulsion and carry it off. This is the greatest potential transport mechanism for materials applied to the target area. A summary and ranking of pertinent pesticide transport mechanisms is shown in Table 5.

In Dallas, spraying of insecticides to entire lawns is commonly done to control soil insects. These insects are less of a problem in Lansing and Philadelphia, so less insecticide spraying of lawns is done.

Application of pesticides as solids is another commmon way of applying a blanket layer of pesticide to a lawn. With this method, the granular formulation is spread over the lawn where the granules tend to lodge in the grass or other cover material and be mechanically trapped. Gentle rain helps settle them into the lawn where they are immobile. Thus, these materials pose a smaller potential pollution problem than the liquids.

TABLE 5

PESTICIDE TRANSPORT ROUTES

Rank*	Route to the Environment	Relative Significance
1	Overland Drainage	
	.Emulsions in Water	Greatest
	.Construction Sediment	Moderate
	.Granular Formulation	Low
2	Intentional Dumping of Leftover Materials	Great (potentially)
3	Accidental Spills	Great (potentially)
4	Container Disposal	Great (potentially)
5	Atmospheric Processes	
	.Evaporation from Land	Moderate
	.Evaporation during Application	Low
	.Drift	
	individual	Low
	commercial	Moderate
6	Movement in Ground Water	Low

*In descending order of importance

Pesticides Associated with Sediment Transport

Erosion and subsequent transport of pesticides on soil is less frequent in established suburban areas than in agricultural lands, due to the permanent nature of lawns around buildings. Only very heavy rains causing flooding are likely to disrupt these lawns and produce sediment transport. However, erosion during new construction can add sediment to a stream, and if the land was previously exposed to pesticides, the potential exists for residues to enter the water.

The amount of pesticides entering the water environment due to accidental or intentional dumping of liquid formulations into a sewer system is unknown. A few homeowners admitted this practice but the number may be larger than indicated. Frequently containers are "reused," with the rinse water being discarded, rather than being added to the solution prepared for application.

Pesticide

Pesticide Applicators, Individual v. Commercial

The suburban user groups surveyed and the quantities of pesticides utilized are summarized in Table 6 below. Among the user groups surveyed, homeowners dispersed approximately 80 percent of the total pestic applied. Thus legislative and educational efforts to prevent pesticides from entering the aquatic environment must be directed toward the homeowner.

TABLE 6

DALLAS, PHILADELPHIA, AND LANSING - TOTAL PESTICIDE USE

	Pesticide (in pounds)*		
User Group	Herbicide	Insecticide	Fungicide
Individual Homeowner	121,600	429,000	68,800
Commercial Sprayer	Neglible	60,900	6,700
Public Facilities**	6,200	29,100	44,000
TOTAL	127,800	519,000	119,500

*Values experssed in pounds of active ingredients.
**Golf courses, parks, mosquito abatement.

Relationship of Pesticide Application Techniques to Run-Off

Pesticides used in the suburban home and garden market are applied by homeowners primarily either as liquids from hose end sprayers or solids from spreaders pushed across lawns. Some higher pressure liquid sprays are used on shrubs and trees but these represent a smaller volume of pesticides than the hose sprayers and spreaders.

In field surveys of homeowners and pesticide manufacturers **investigation** determined the average suburbanite applies pesticides at very distinct times - four weekends in May, with some applications the last weekend in April and the first weekend in June. These will be referred to as application weekends. Thus there are **6 or** 7 weekends each year during which 85-90 percent of all home and garden pesticides are applied. If it rains these weekends the pesticides are not applied. From weather bureau records **investigation** determined that each of the study cities had about an equal number of rainy weekends in the last four year period for which data could be obtained. Each of these cities experienced about 6-1/2 rainy weekends out of 25 potential application weekends during the last four years.

Other rainfall data collected show the number of times rainfall occurred in the first few days following application. Heavy rains producing large amounts of run-off soon after pesticide application can carry pesticides with them. In Lansing, there were four weeks with heavy rains following an appliation weekend, in Dallas there were two and in Philadelphia four.

The short and concentrated application season for home and garden pesticides increases the pollution potential from this source and clearly shows the desirability of monitoring run-off during these application periods.

Table 8 shows the possible conditions of rainfall during and following application weekends and the resulting potential for contamination of water by liquid applied pesticdes. Only a dry weekend followed by a wet week has a potential for contamination of run-off waters.

Since this set of circumstances cannot be controlled and cannot be accurately predicted several days in advance and since pesticides are liable to be used under these unfavorable conditions, clearly the most effective way to minimize the pollution potential is to minimize the run-off potential of pesticides by formulation and or application improvements.

Research into very short lived emulsifiers, those with a 10-15 minute working life after application, should receive attention. Application of more pesticides as granules instead of liquids would also help to lower this peak.

TABLE 8

POTENTIAL FOR WATER CONTAMINATION BY LIQUID HOME AND GARDEN PESTICIDE APPLICATION

Weekend Weather/ Week's Weather	Rainy	Dry
Dry	I Low (1)	II Low (2)
Rainy	III Low (1)	IV Very High (2)

(1) No application - bad weather keeps homeowner inside.

(2) Application will occur. No run-off to cause problems.

Pesticide Monitoring Data

Measurement of pesticides in urban area waters is almost non-existent. The few measurements uncovered during this work were on a yearly grab basis and provided no meaningful base to work from. The criteria for collecting samples should be rainfall and run-off, to verify the amount of pesticide lost from the urban areas.

In one of the few instances where pesticides were measured in actual run-off under field conditions, Edwards and Glass measured methoxychlor being removed from pastureland grasses in Ohio. This pasture grass was not a suburban lawn; but rather a mixture of coarse field grasses that was not mowed to the short length of a lawn. These measurements are important because they represent pesticides in run-off from a stable, non-plowed field. Soil erosion does not occur under such conditions and the resulting loss of pesticides adsorbed on soils do not occur.

Glass and Edwards applied methoxychlor in March at a very heavy dose of 22.4 kg/ha or 19.9 pounds/acre. This rate far exceeds normal agricultural application rates and, according to contractor estimates, is about twice the maximum rate applied by home and garden users. Run-off was sampled after all rainfall for 14 months following application; the total methoxychlor removed in run-off was found to be 0.004 percent, a seemingly insignificant amount of the applied dose. No pesticide was found in the ground water below the test plot throughout the study. The implication of this study is that once applied to the stable situation of grass cover the pesticide will remain and not cause water contamination. No run-off occurred for six days after the methoxychlor was sprayed onto the field, allowing some time for the spray emulsion to break before rainfall occurred. The first run-off had only 0.1 ug/l of methoxychlor in it.

Empty Container Disposal

After a container is "emptied," it is usually thrown in the trash for private or municipal pick-up and disposal. Then the container is either buried in a landfill or incinerated. Both of these techniques are potential causes of water pollution.

Water percolating through a landfill can contaminate ground water in the region; if pesticides are present they could be carried by the percolating water into the ground water beneath the landfill. If incinerated, the pesticide container could contribute to water pollution through quenching water or flue gas scrubbing water if the incinerator temperature is not sufficeintly high or is not maintained at a constantly high temperature.

DEGRADATION OF HOME AND GARDEN PESTICIDES

The survey results detailed in Appendix A of this report indicate that a large number of different pesticide active ingredients are contained in home and garden pesticide products. These active ingredients represent a variety of different chemical groups. Many of these chemicals are also used for agricultural and other pest control purposes. Many of them have been in commercial production and use for many years, including the phenoxy-type herbicides, atrazine, chlordane, dieldrin, methoxychlor, carbaryl, malathion, diazinon, PCNB, captan and others.

The Problem of Degradation

In recent years, many expert committees, panels, conferences, and symposia have dealt with practically all aspects of pesticides, including their fate in the environment after application. Publications emanating from these activities include a report by the American Chemical Society entitled "Cleaning Our Environment - The Chemical Basis for Action;" proceedings of an international symposium on "Pesticides in the Soil; Ecology, Degradation and Movement" which was held at Michigan State University, East Lansing, in February of 1970, and the "Report of the Secretary's Commission on Pesticides and Their Relationship to Environmental Health," U. S. Department of Health, Education and Welfare, more popularly known as the "Mrak Report," after its chairman.

Perusal of these and many other comprehensive studies and reviews of the state of the art by our best experts leads to the disturbing conclusion that, in effect, very little is known about what happens to pesticides in the environment after application under actual field conditions. Many investigators have studied individual factors or subsystems under laboratory conditions, but it is not clear, and the authors themselves usually are silent on the question, whether the results reported are applicable or even relevant to field conditions.

Organic pesticides are known to be metabolized by living systems by processes of hydrolysis, hydroxylation, removal of halogens, oxidative and non-oxidative reduction, conjugation and desulfuration. More than one site on the pesticide molecule may be subject to attack. Plants, animals and microbes are known to metabolize many pesticide compounds by similar pathways under laboratory conditions.

It is surprising as well as deplorable that so few scientists in this area have ventured into studying what really happens in the field. As a result, very little is known about the pathways of metabolism and degradation and about the nature of the ultimate breakdown products of pesticides under field conditions. Not knowing the nature of these degradation products, we of course know nothing about their fate and effects in the environment.

Information on the degradative mechanisms and on the chemical nature of metabolites and breakdown products is, of course, also important to the development of analytical methods suitable for monitoring work. Methods which are sensitive only to the parent compound are of limited value in efforts to determine the total environmental impact of chemicals.

While this type of information is lacking even for pesticides which have been in large scale commercial use for many years, including those mentioned above, it is likewise unavailable for pesticides which have been developed more recently and have thus far been registered and used primarily on non-food crops. Products in this category include the herbicides Bandane and bensulide; the insecticide Aspon, and the fungicide benomyl.

Toxicity, Synergism

Many of the compounds which are suggested for use in lieu of chlorinated hydrocarbons, e.g., organo-phosphate and carbamates, are known to degrade very rapidly under laboratory and field situations. Quantitative data on the toxicity of metabolites of these groups is largely lacking. It is known, however, that the primary metabolites of some are even more toxic than the parent compound. This feature, plus the heavy additions of inorganic materials, heavy metals, industrial compounds, domestic sewage with high BOD, etc. from municipal sources, creates a potentially greater pollution hazard from these areas than from strictly agricultural regions.

Many of these non-metabolic features of the environment (above), including additional alteration of temperature, pH, alkalinity, etc. all act in consort to alter the basic metabolic physiology of aquatic organisms and make them more subject to the harmful effects of pesticides and their degradative residues.

Pesticide Persistence

The contractor feels that its estimates of quantities of pesticides applied are reasonably valid under the conditions of the survey. When one compares these figures to values monitored from various urban areas, it is seen that one can account for about one year's application at most. What has happened to the residues? They may have been degraded, of course, but studies on undisturbed soils suggest that the organo-chlorides will persist for many years when plowed down. It is entirely possible that the majority of urban and suburban applications are more surface oriented and that they never get down into the soil. Thus, the increased propensity for vaporization, photo-alteration and runoff, all of which remove the compounds from the application site and contribute them to the aquatic environment, are global contamination. Relatively shallow cultivation probably contributes toward keeping the chemicals at or near the surface.

The chief conclusion to be drawn from this situation is that our knowledge about the fate and degradation of pesticides in the environment is very small indeed. This is especially true of the home and garden area. The type of research required to fill these knowledge gaps is quite complex and therefore, expensive and time consuming.

It is unlikely that such an effort would be justified or supported for a chemical which is used only in the home and garden pesticide market. However, it is hoped that with the increasing general concern about these matters, research will soon be initiated to systematically resolve these questions, at least for the most important agricultural pesticides. The information to be obtained from such studies will be very useful in gaining a better understanding of the fate of home and garden pesticides, and in reducing or eliminating practices and products which may have a high environmental pollution potential.

Decidedly different features characterize the urban-suburban contribution of pesticides to the water environment than those of agricultural use. The contractor's survey and analysis of use patterns indicates that roughly fifty percent of each type of organochlorides with relatively low acute toxicity and long persistence, and, carbamates and phosphates with relatively highly acute toxicity and much shorter persistence, are used. This is in contrast to the results from a five state agricultural area (EPA No. 68-01-0117) where the use of organochlorides was more than fifty to seventy-five times the use of organophosphates and carbamates combined.

Short Term Effects

Such a point source of highly toxic compounds, even though they degrade quite rapidly in soil or water, could, under appropriate conditions, constitute a serious health hazard for aquatic life. It should also be noted in passing that if damage to the aquatic environment could be demonstrated either by outright death or reduced population of organisms, the suspect material, if it was a rapidly degradable compound, would, in most cases, be degraded before adequate identification could be completed. The same is not true, of course, for the more persistent organochlorides. Of particular impact here is the fact that the same point source, whether it be sewage outfall or storm water drainage, could, through its heavy load of acutely toxic compounds, so weaken or debilitate aquatic organisms that lower levels of organochlorides would now become more lethal through the combined or synergistic effects of both. Such a problem does not appear to exist in areas of intensive row crop cultivation generally.

It has been demonstrated that peak rainfall and time of application coinciding as they do over much of the country, presents a particularly threatening situation during the spring and early summer. It should be remembered that this is the time of year of maximum growth and food conversion for fishes as well as the period of most active reproduction, incubation, and development of young.

Examination of population densities and river discharge patterns suggests that east coast estuaries stand to suffer the greatest potential harm during the months of April, May, June, and July when the greatest amount of soil is disturbed and application of pesticides is the greatest. The impact of suburban and urban use here is contrasted to the interior drainage of the Mississippi Valley and associated drainages, where lesser populations in suburban areas add to the already heavy load of agricultural chemicals. These combined contributions pose a more serious threat to fresh waters of the interior of this basin than to the Gulf coastal estuaries, the more toxic compounds generally having been degraded during their time of travel to coastal estuarine waters.

Certain portions of central and southern California estuarine areas have a high potential for harm through the combined actions of heavy residential use of toxic compounds, heavy, intensive agricultural use of both toxic and less toxic compounds and the outfall from manufacture and formulation of highly persistent but less toxic chemicals.

Short term effects, then, could be noted in the outright death of aquatic organisms in some local static situations. The effects of pesticide translocation resulting from heavy rainfall would probably leave little effect on the aquatic environment due to the considerable dilution involved.

Long Term Effects

It has been clearly shown that many aquatic organisms can accumulate pesticide compounds even from extremely dilute concentrations. It has further been demonstrated that on a weight basis, many elements of lower trophic levels, primary producer groups, and second level or primary consumer groups, have the ability to concentrate pesticides at a higher rate than higher trophic levels. This point is vitally important since exposure, even for a very brief period, will result in some portion of the pesticide load being incorporated into the food chain immediately. The remaining, often larger, portion is bound, at least for a time, to inorganic and organic particles. Release from these sources into the food chain follows at a slower rate.

Until we know more about the ultimate fate of metabolic degradative compounds, little will be known about the impact of these compounds on aquatic organisms. We do know that complete degradation into totally harmless compounds usually follows rapidly after primary metabolic attack in the case of organophosphates and carbamates.

Many herbicides show intermediate persistence; addition of these compounds to public waterways could seriously reduce growth and photosynthetic activity in aquatic plants. Many cases are on record where heavy applications of herbicides caused heavy "die-off" of aquatic plants, with subsequent high oxygen demand generated by the mass decomposition. Such a situation has been previously described as being potentially harmful to aquatic animals in that the lowered oxygen content weakens animals and makes them more susceptible to pesticide effects in lower concentrations. It is doubtful whether the suburban contribution of herbicides will ever be responsible for mass "die-offs" but low level chronic exposure could easily reduce plant growth and vitality, thereby seriously impeding one of our natural purification systems.

The annual application of organochloride compounds (30-60 million pounds) by home gardeners, home pest control applicators and municipal authorities, although it is less than the agricultural use of these compounds, nevertheless makes a considerable contribution to potential environmental contamination.

Chronic exposure to low levels (sublethal) or organochlorides has been shown to reduce photosynthesis in both marine and fresh water algal species. Several bacterial species have developed an induced resistence to these compounds. No long term full studies have been conducted to demonstrate the long term effects of pesticides on phytoplankton or periphyton species or community structure and/or metabolism. It appears that no long term, low level exposure studies have been conducted in laboratories, either.

Aquatic crustacea, a major contributor to zooplankton, are generally more resistant to organochlorides than to organophosphate or carbamates. A notable exception is their extreme sensitivity to DDT. Fishes, on the other hand, are generally less susceptible to organophosphates and carbamates than to organochlorides. A significant point is the fact that many of the common zooplanktons are capable of accumulating quantities of organochlorides several thousand times the concentration in ambient water within one day.

Aquatic insect larvae, another important component of aquatic food chains are observed to exhibit a wide variety of responses with the more fastidious species being generally more susceptible to intoxication than the less demanding species. All forms examined so far are capable of considerable degrees of bio-magnification. An insufficient number of different groups have been examined to date to make a really valid statement.

Fishes have been the most widely examined group of aquatic animals due to their economic importance and their position as upper trophic level consumers. Studies to date have identified an alarming array of responses to long term, low level exposure. Among these are, behavioral alteration disturbances, especially nitrogen metabolism; endocrine imbalance, particularly in regard to osmoregulatory failure; and, mineral imbalance and reproductive failure due to steroid hormone disturbance.

Common to both fishes and other lower trophic level animals, has been the reduction of growth rate generally, as a result of altered food conversion; altered reproductive potential, both in terms of number of eggs produced as well as survival of young.

A feature common to all aquatic organisms would appear to be reduced fitness and increased susceptibility to disease, capture or the effect of parasitic infection as a result of long term, low level exposure.

Aquatic Food Chain

There is abundant evidence to point to accumulation and biomagnification within aquatic food chains. The fact that we do not see many cases of outright death to fishes in no way detracts from the potentially harmful effects of chronic exposure to this group. Ecological efficiencies of about ten percent per trophic level are common. Biomagnifications of nearly one order of magnitude are seen to occur at each of the lower trophic levels. Residue values for higher trophic levels may or may not reveal such magnification due to differential rates of metabolism and degradation. The fact that the residues of top trophic levels do not reflect such magnification at any given sampling does not mean that the animal was not subjected to the potentially harmful influence of metabolizing heavy body burdens of chemicals.

Limited data exists for other aquatic animals. What is available suggests that toads, frogs, and salamanders may be highly susceptible to the levels of pesticides which might occur from suburban and municipal pesticide use. These groups, along with snakes and turtles, are virtually unmentioned in the literature. Clearly, much research is needed.

Those birds which feed on fishes and other aquatic life can be regarded as the top carnivores of aquatic chains. Adequate documentation is available to point clearly to reproductive failure and diminished population numbers. Hepatic microsomal enzyme induction and disturbed steroid and calcium metabolism is probably at fault.

Synergistic Effects

As described earlier in this report, home and garden pesticides contain a great variety of different chemicals as active ingredients. Occurrence of synergistic effects is therefore definitely a possibility, between different chemicals formulated together into one product as well as between chemicals which may arrive at the same site in the environment from separate applications.

Synergism is present when the effect of two chemicals applied together is greater than the sum total of their independent effects. Among pesticidal chemicals, a number of instances of synergism have been reported. The commercially most successful application of this phenomenon is the enhancement of the insecticidal effectiveness of pyrethrins by "pyrethrin synergists" such as piperonyl butoxide, sesamin and others. Many other cases of synergism between pesticides have been reported in the literature. Most of these were observed in terms of increased toxicity of the combined chemicals to laboratory cultures of insects, or to laboratory mammals.

Very few investigators have addressed themselves to possible synergistic interactions between pesticidal chemicals or their residues in the environment after application. The contractor's search of the literature in this regard did not yield any reports applicable to the present study. This is an area which is very little explored.

It should be pointed out that field research in this area is regarded as extremely difficult due to the multiplicity of environmental factors involved.

Health Hazard to Humans

The primary health hazard to humans would appear to arise through the careless use of organophosphate and carbamate compounds. As the more persistent chemicals are eliminated from use, the use of these alternatives can be expected to increase. Most of these compounds are considerably more toxic to warm blooded animals than are the organochlorides. Standing in spray drift or other physical contact with concentrated solutions will pose a threat from these potent cholinesterase inhibitors. Ingestion of these compounds by children, with tragic consequences, through the careless handling of the original package, is sure to increase unless the full support of state and local authorities can implement a workable plan of education and information.

PESTICIDE ALTERNATIVES

From the more detailed discussion in Appendix E, we arrive at the following conclusions regarding alternative methods of controlling lawn and garden pests:

Methods such as microbial agents, juvenile hormone mimics or pest management systems which look very promising for use on some agricultural crops and pests are not likely to be employed in the lawn and garden area in the near future.

Organic gardening methods appear to work well in the hands of a small and dedicated group of believers in them. A well developed "green thumb" combined with considerable biological knowledge seem to be prerequisites for the success of completely non-chemical gardening.

The large majority of suburban gardeners consider "pure" organic gardening methods too cumbersome and time-consuming, and they do not have the patience and the basic know-how necessary to make them work.

Consequently, we do not believe that suburban gardening entirely without chemicals is a realistic possibility in the foreseeable future. We do believe that there is room for improvement of the products and practices which are presently employed for the control of lawn and garden pests.

An overwhelming majority of suburban gardeners are keenly aware of the "pesticide problem" in relation to the environment. All are aware, for instance, of the DDT issue. In our opinion, suburban gardeners would be most receptive to more information and more practical advice on how to translate these concerns into action. They need realistic guidance on how to select products and practices which will preserve and enhance the environment and minimize damage to non-target organisms and pollution from pesticide run-off.

Manufacturers of home and garden pesticides, especially those operating nation-wide, are keenly aware of the fact that their clientele is the public at large (in contrast to the marketing of agricultural pesticides), and that this clientele is concerned about the quality of the environment. Their efforts to develop environmentally more desirable products are hampered by the present lack of methods and yardsticks by which to measure and monitor the environmental damage potential of chemicals.

Federal and state extension specialists and other public officials dealing with lawn and garden pests and their control share the public concern about environmental quality and have developed a great deal of useful information, advice and control recommendations with these concerns in mind.

A major obstacle to more effective communication and cooperation between these three groups - suburban gardeners, home and garden pesticide manufacturers and public agencies - lies in the area of pesticide nomenclature. Lay gardeners know home and garden pesticide products only in terms of brand names and trade names. Public agencies refer to pesticide active ingredients only in terms of common names or chemical names. Present practices of identifying active ingredients on home and garden pesticide labels make it practically impossible for the lay person to utilize public agencies' recommendations.

APPLICABLE LAWS AND REGULATIONS

The contractor has endeavored to examine and present in concise form, the status of Federal and state laws directly pertinent to the states and three cities. By collecting and analyzing pertinent laws at the state and Federal level, and through a series of interviews with key people, a picture of good and bad has been assembled; each will be presented with the contractor's evaluation of areas of needed reform.

The Federal regulation of pesticides operates under the Federal Insecticide, Fungicide and Rodenticide Act (FIFRA), enacted in 1947 and amended in 1959, 1961, and 1964. The act prohibits the interstate or international shipment of economic poisons unless they are: registered pursuant to provisions of Section 4 of the act, are in unbroken immediate containers, and are labeled according to the provisions of the act.

Should the Administrator find that an imminent hazard to the public would exist, he may suspend the registration of an economic poison immediately. Any person who violates this law may be found guilty of a misdemeanor and on conviction can be fined not more than $1,000.00.

New Federal Legislation

During 1971, Congress has considered legislation to amend or replace FIFRA. At least eight different bills dealing with pesticides were introduced in the House of Representatives. The primary one was H. R. 4152. In the Senate four bills have been under consideration, two of which (S. 600 and S. 745) would - like H. R. 4152 - replace the present FIFRA. The other bills would either prohibit the sale of DDT or prohibit the sale of aldrin, chlordane, DDD/TDE, dieldrin, endrin, heptachlor, lindane, and toxaphene. The fate of any legislation in the Congress is to be considered uncertain until enacted by both Houses and sent to the President. H. R. 10729, the Committee rewrite of H. R. 4152, was enacted by the House in the first session of the 92nd Congress. There is strong expectation that Senate action in the 1972 session will result in enactment of a new FIFRA very similar to H. R. 10729.

H. R. 10729 incorporates many of the provisions of the existing law (FIFRA), but goes well beyond it in the federal regulation of intrastate as well as interstate activities, including registration of pesticides in intrastate commerce. It provides for the classification of pesticides as to: (a) "general use" or (b) "restricted use." The original versions had a third category of "use by permit only." It also provides for the certification of pesticide applicators. It provides for aid and guidance to states in developing training programs for pesticide applicators and for the certification of individuals entitled to use restricted pesticides.

The bill also substantially increases the enforcement powers of the federal agency. There are provisions for criminal misdemeanor and for civil penalties. These include not only the registrant, wholesaler, dealer, retailer, or other distributor, the commercial pesticide applicator, but the farmer who "knowingly violates any provision of the Act."

Impact of the Pending Federal Legislation

The contractor views the pending legislation as (1) an integral part of more effective pollution control, (2) improved control of commercial and private applicators to prevent overdoses and careless applications, (3) more effective handling of pesticides, (4) reduction in on-site storage of pesticides, and (5) more effective control over retail sales subject to recall on order of the Administrator.

City and urban community officials seem to be generally concerned with this opinion. When contacted they were, for the most part, helpful and seemingly aware of the necessity to control certain areas of pesticide use. These people felt generally that their offices have tried and were trying to implement programs tending to minimize possible environmental damage. Many felt that some retailers and formulators were using practices designed to circumvent existing regulations and most felt that the pending Federal legislation would be of material help. As might be expected, the greatest opposition came from some retailers and commercial applicators - both groups saw the impending legislation as too restrictive.

The contractor believes that most commercial structural applicators, including the common household pest applicators are responsible and honestly try through national and local organizations to follow reasonable guidelines. There is, however, a large group of "cut-rate" applicators operating in most major cities around the country who are opportunistic and in many cases require only a merchant's license and a spray can to be in business. Health officials are concerned because these operators do a job which many municipalities cannot do; the reputable applicators are quite vocal in their opposition to this group, feeling that they give the industry a bad name.

Section 20, Research and Monitoring, and Section 23, State Cooperation and Training of H. R. 10729, are particularly significant advances. The provisions which specifically empower the Administrator to (1) foster research in biologically integrated alternatives for pest control, (2) formulate a national plan for monitoring, (3) expand public funds to encourage state programs in training of certified pesticide applicators, are viewed by the contractor as necessary and desirable.

Testing and Registration of New Pesticides

Section 3. Registration of pesticides appears to provide for sufficient information to allow the Administrator to make adequate judgments regarding new compounds. The provisions which allow a full description of tests performed, §3(c)(1)(D), and the results thereof to the Administrator as he desires and §3(c)(1), wherein the Administrator shall publish guidelines specifying the kinds of information required in support of registration, are regarded as particularly important. The further provision that the Administrator shall make public all scientific information relating to the registration of any particular compound is viewed as an absolute necessity and long overdue (S 23(c)(2), p. 18, lines 4-9).

State Law Summary

Texas - The Texas Economic Pesticide Law of 1971 is simple and direct. Although it does make provisions for the establishment of an Advisory Committee, it is felt that additional members should be added to make more equitable decisions possible. Apparently part of the burden of determining whether certain pesticides possess "serious uncontrollable adverse effects" or are "of greater detriment to the enviroment" than "the benefits received by its use" etc. will fall on this committee.

Authority is still vested in county commissioner courts to ameliorate portions of the state herbicide law which is a kind of use and appliation provision. Such authority may be subject to abuses in certain cases. No insecticide use and application provisions are currently in force. Most of the bills which were offered but which did not pass in 1971 were really too broad and under the existing law would have been difficult to interpret in individual cases. The distribution of more stringent commercial applicator laws or a restricted use provision encompassing chlorinated hydrocarbons would have been desirable but were not passed. Texas was a large user of raw DDT which was formulated for use in the state. The recent ban on interstate shipments of DDT will materially affect this use.

Pennsylvania - This state's existing law is fashioned generally after FIFRA. No restricted use clause or use or application law is included. The fate of many of the pending bills is in doubt. Generally speaking, the offered bills were much more restrictive than existing law. Restricted use provisions, the prohibition of chlorinated hydrocarbon pesticides, except in emergency, are received as desirable. This state will probably find it easy to accept the pending Federal legislation.

Of particular noteworthiness is Senate Bill 668 which would grant authority to the Department of Environmental Resources to establish centers to collect and dispose of non-biodegradable pesticides.

Michigan - Michigan already has adequate provisions for testing and licensing of applicators. Annual review and renewable clauses are deemed desirable.

The Pesticide Advisory Board in this state (cf. Texas) is constituted of members more directly concerned (and knowledgable) about environmental contamination and potential health hazard to humans. Additional licensing provisions and the inclusion of restricted use categories in legislation passed in 1971 are seen as desirable additions to the law. This state will have no problem with the Administration Bill (H. R. 10729) since many of their provisions are already more restrictive than the proposed Federal law. The provisions of the existing law do not, however, specify restricted use pesticides, it merely grants the authority to the Department of Agriculture to designate such.

A public hearing was scheduled for December 9, 1971, on Michigan's Department of Agriculture proposed Regulation No. 633. This proposed regulation provided for the identity of restricted use pesticides and their formulations; who may sell them and for what purposes; as well as licensing and examination and reporting of sales provisions for such compounds. Such a regulation, with the full support of the Department of Agriculture, is seen as very worthwhile legislation.

None of the suburban areas around the cities of Dallas, Philadelphia, and Lansing have regulations or local ordinances which materially alter the existing state laws. Only a few local restrictions on DDT use have been identified.

Identity of Favorable Types of Laws

Although some states presently have laws which appear to control use and application, it is seen that sufficient control is not observed in practice at all times. Hopefully, the provisions of the bill, which would strengthen or reinforce Federal aid to educational programs designed to improve methods of application and human safety, would have their impact in increased environmental protection as well.

Some of the verbiage of the existing state laws is rather loose in the interpretation of how to dispose of containers and unused pesticides. Hopefully this major source of environmental contamination will be solved by more useful state laws in the future. As indicated in another section of this report, many householders have expressed an earnest desire to dispose of their material in a suitable way but do not know of a practical solution. Aid in this matter should come from all states as soon as possible (see Pennsylvania Senate Bill 668).

Studies on various soil types indicate that considerable residues exist in urban and suburban soils around the country. Means of identifying this residue level would be desirable. The activities of State Departments of Agriculture through the Agricultural Extension Service are well known to farmers. The activities of this group as well as the valuable services and information they provide are much less well known to suburban and urban home gardeners. Provisions of the proposed Federal legislation which would augment educational programs in the various states is viewed as a very desirable feature and one which would materially aid this heavy pesticide use group.

The strengthening of applicator laws is viewed as another very desirable feature of some state laws. However, responsible operators who perform valuable services should not suffer from over-regulation.

RECOMMENDATIONS

Use Patterns

1. To obtain a more complete picture of the total national pesticide input into the environment, collect information on the distribution and use patterns of about 500 million lbs. of pesticide active ingredients which are produced annually, but not accounted for by farm use.

2. Extend the present study to other geographical areas so as to obtain an estimate of the total national home and garden pesticide consumption.

3. Extend study to all other non-farm pesticide uses which, together with home and garden uses make up the 500 million lbs. of pesticides about whose disposition we currently know so little.

Transport Mechanisms

4. Verify the relationship between application techniques and runoff for liquid and granular pesticide formulations through simulated field conditions.

5. Establish monitoring networks to record daily levels of pesticides at sewage and water treatment plants and peaks from storm runoff to generate enough data to allow an accurate inventory of pesticides entering water from suburban use. This should include samples collected

during and after storms to catch the runoff peaks as well as a few continuous (daily) samples at locations such as waterworks facilities, where water quality is already monitored, and should include sediment as well as water analyses.

6. Establish educational programs through mass media to show better ways of disposing of left over materials and empty containers. Approaches such as deposits on returnable cans might help keep the containers away from the water environment. Another approach could be the creation of pesticide collection stations where empty containers could be taken for proper disposal during each of the application weekends.

7. Develop emulsions which will persist only a few minutes after application, thus reducing the chances of subsequent rain carrying pesticides away from the target.

8. Institute, by legislation, different programs of land clearing during construction. Allow only that area actually required to be disturbed for construction to be denuded. Reduce practices such as mass removal of trees and bushes which break the force of rainfall and help check erosion.

9. Institute a series of storm runoff control devices which keep runoff at a low level longer, and catch

sediment in the process, keeping the sediment on the land rather than allowing it to enter the waterways. If a large area must be disturbed in construction, encourage the planting of rapid growing materials, such as black mustard weed, which would provide temporary ground cover to reduce erosion.

10. Formulate all possible pesticides as granules rather than liquids for sod applications.

Degradation

11. Encourage and support down-to-earth, interdisciplinary research on the fate and degradation of pesticides in the environment under field conditions.

12. Investigate and identify the major metabolites in several animal groups before final registration of new products. This should include at least one warm blooded (rat, mouse, rabbit, dog) and one cold blooded animal (suitable fish) and one or more common invertebrate species, at least one of which is an aquatic organism.

13. Investigate and identify the major metabolites in several plant groups before final registration is granted. For herbicides these should include several terrestrial non-target species. For both herbicides and pesticides, the metabolites of several aquatic species of filamentous algae as well as common diatoms and unicellular algae of the primary producer group should be identified.

14. Investigate and identify the nature of metabolites and extent of decomposition of new products by common soil and water microorganisms before final registration is granted.

Impact on Aquatic Environment

15. Support additional needed research in the area of synergistic effects of pesticides with each other and in combination with other environmental variables; particularly effects of reduced oxygen tension, pH, alkalinity, temperature, heavy metals, etc.

16. Establish improved monitoring systems which would identify levels of contamination at various trophic levels especially in and around major metropolitan areas.

17. Support laboratory and field studies on long term effects on growth and population dynamics. These should include experiments designed to examine the effects of pulsed, (repeated) exposures to sub lethal concentrations of more acutely toxic compounds. All elements of aquatic ecosystems and trophic levels must be stressed.

18. Establish basic guidelines for the conduct of experimental research programs. The thrust of this should be toward insuring greater conformity and achieving greater comparability between data. Especially useful data should

be sought which identifies rates of accumulation under varying conditions, particularly concentrations, and total quantity of chemical the test animals are exposed to.

19. Support basic research on the effects of combinations of pesticides most commonly used by home gardeners on primary carbon fixation.

20. Institute a workable plan of information retrieval for all elements of the aquatic ecosystem as well as terrestrial. Compliance or voluntary cooperation is absolutely necessary by each state. Support may have to come through Federal withholding of support monies. Such a plan could make already gathered data available for analysis as well as predicting where duplication of effort might occur.

21. Continue to support and expand studies on basic physiological responses of fish and other aquatic vertebrates to pesticides under chronic sublethal exposure. This ought to include expanded studies of effects of heavy metals/pesticide synergisms.

22. Establish a means whereby the kinds of information generated by points, 11-17 and 19, 21, if produced by manufacturers or formulators, is subject to examination by the at large scientific community - with due regard for corporate integrity and confidentiality.

Alternatives to Pesticide Use

23. To make home and garden pesticide labels more meaningful to the user and to facilitate lay persons' understanding of research findings and recommendations by Federal and state agencies, make it mandatory that all active ingredients be identified by common names.

24. Encourage public agencies, gardening organizations and home and garden pesticide manufacturers to cooperate in the development of meaningful, practical information and advice on how to control pests around the house and yard in such a way as to reduce actual and potential environmental harm to a minimum. Furnish suburban gardeners easily understandable, unbiased information on the properties of pesticide active ingredients and on their potential for environmental harm in terms which they can relate to product labels.

25. Develop and furnish to suburban gardeners practical information on the pollution potential of different pesticide use methods. Examples: dry granular lawn insecticides are less liable to produce runoff than liquid sprays; are multi-purpose "convenience" products really necessary?

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26. Since over eighty percent (80%) of the total pesticide load applied in homes and gardens is applied directly by the homeowner, it is apparent that this group needs to have as much or more control exercised over them as do commercial applicators or farmers. By and large, this group of people are extremely naive about the compounds they apply. They appear to rely on promotional criteria and salesmanship, rather than the actual product required for a specific job. One form of restraint would obviously be in what is available to them. This group should have free, unbiased recommendations for use and application, as well as means of disposal. Federal support of educational programs is anticipated.

27. The use of some persistent compounds appears warranted where it can be clearly demonstrated that possible contamination of the environment is highly unlikely. Structural pest applications where the material can be worked down or otherwise prevented from vaporization or runoff are suggested. The further use of more persistent compounds may be justified when the preservation of a valuable crop (a seldom occurrence in the home and garden use of pesticides) is confronted with an extreme emergency.

28. The careless and reckless "dollar-a-room" pesticide applicator obviously needs some restraint placed on his activities. Licensing, which includes examinations or testing for knowledge, the posting of an adequate bond and other controls supported by a rigid enforcement program are desired.

29. Passage of the Administration Bill (H. R. 10729) as well as full state and Federal implementation of its provisions is urged. Although directed primarily at agricultural activities, its content clearly would have a profound influence on suburban and urban pesticide use.

30. Interdisciplinary research and down-to-earth thinking will have to be combined to answer many of the questions outlined above. Industrial and independent research and consulting organizations have much experience, and have had much success in practical, problem-solving research. This type of experience is greatly needed in this complex area of environmental research and should therefore be engaged to the maximum extent possible, along with other appropriate research sources.

APPENDIX A

HOME AND GARDEN PESTICIDE USES

Selection of Study Cities

Throughout the United States, an ever increasing land area becomes part of "suburbia" with the continuous growth of our cities and the addition of new subdivisions along their outskirts. Lawn is probably by far the biggest U. S. "crop."

The kinds and species of grasses, flowers and trees grown in suburbs throughout the United States vary almost as widely as the climatic and soil conditions and other elements of the physical environment. Likewise, there are great differences between regions of the country in the insect, disease and weed problems affecting these plantings, and in the chemical and other measures of control used to combat them. The contractor therefore thought it advantageous to study home and garden pesticide uses and their environmental impact in several different geographical areas. In consultation with the Environmental Protection Agency, the cities of Philadelphia, Pennsylvania, Dallas, Texas and Lansing, Michigan were selected as representing three distinctly different geographical regions and, in addition, a certain variance in size of metropolitan areas. A more detailed description of each study city will be given below.

It would, of course, have been desirable to include additional geographical regions, but this was not possible within the limits of time and resources available for the performance of the present investigation.

Prior Information

The U. S. Tariff Commission stated in a preliminary report dated September, 1971, that a total of 1.034 billion lbs. of active ingredients of pesticides and related products were produced in the United States in 1970. This quantity included 404 million lbs. of herbicides; 490 million lbs. of insecticides and 140 million lbs. of fungicides.

Eichers (one of the few nationally known authorities on pesticide use statistics) described the use and disposition of the total U. S. production of pesticides as follows in a recent symposium: (2)

> "More and more information is becoming available on farm use of pesticides. We may soon have a fairly good impression of how much of which pesticide products farmers use on what crops in different sections of the country ..... However, the existence of any systematic tabulation of pesticide use and effects ends here. While we have several recent enumerations attempting to identify farm use of pesticides, there is almost no statistical information on non-farm use (by public agencies, industry and home owners). And, to my knowledge,

> there are no current proposals for obtaining information on these areas of use. Yet farmers account for only slightly more than one-half of all pesticides used in the United States."

This is a very succinct, authoritative statement on the present, almost total, lack of information on the fate and disposition of about 500 million lbs. of pesticide active ingredients per year. Home and garden pesticide uses share this total quantity with government and industrial uses, but the actual pesticide quantities consumed annually by these two latter groups are equally unknown. Thus, this contract study as designed by the EPA represents the first systematic effort by any government agency to shed light on this unknown area.

One of the specifications of this contract included a request for "an inventory and description of pesticide uses in the area, including a tabulation of quantities and types of major pesticides used and the pests toward which their use is directed." It was obvious from the outset that this inventory would be one of the key tasks in this study because the pesticide inputs into the study areas would have to be known in terms of specific chemicals and quantities before most of the subsequent tasks could be undertaken.

Survey Methods

For purposes of this case study, the contractor defined "the use of pesticides in suburban homes and gardens" (as set forth in the contract specifications) to include pesticide uses by suburban residents, commercial tree and lawn sprayers, golf courses, city and county Parks and Health Departments and similar agencies. Industrial or residential indoor uses of pesticides in the center cities, i.e., for rodent control, were not included. The contractor also did not include pesticide uses by professional exterminators for structural pest control, such as termite control, because it has been shown that pesticides used properly and professionally for these purposes do not move away from the site of application and therefore do not contribute to contamination of waterways.

Furthermore, within the geographical boundaries described below for each study city, the contractor defined the "suburban area" as the total land area carrying single family dwelling units, plus adjacent parks, golf courses, and similar lands.

The methods used, and the agencies and individuals contacted to arrive at a meaningful estimate of the total quantities of pesticides used in suburban homes and gardens in the three cities are as follows:

State Agricultural Experiment Station and Extension Services. State University research and extension workers in the fields of horticulture, entomology, plant pathology, weed science, and environment-oriented disciplines were very helpful in giving the contractor a general overview of the most important lawn grasses, ornamental trees, shrubs and flowers; of the insects, weeds and diseases affecting them; and of the major pesticides recommended and used in their respective areas. They also gave the contractor many suggestions as to other agencies and individuals to contact.

Regional, County and City Planning Departments. Planning Departments were contacted initially for information on the number of acres and/or the percentage of suburban land built up and under pavement versus land in suburban lawns and plantings, golf courses, parks, etc. The contractor learned that this type of land use data is not available in any of the three study cities. However, the Planning Commissions were able to give the contractor information on the number of single family dwelling units in their respective areas, also the number of owner-occupied dwelling units in eight different valuation brackets, ranging from less than $5,000 to more than $50,000. These data from the 1970 census proved very helpful in extrapolating the pesticide use data from individual residences (see below). Not surprisingly, the contractor found that there are definite correlations between property valuation and dollar expenditures for home and garden pesticides.

City and County Health Departments. In each city, it was determined if and to what extent Health Departments were using pesticides for mosquito control or other purposes. Where such programs were in effect in 1971, the agency or agencies conducting them were contacted. Most of them were very cooperative in furnishing the actual purchase figures or estimates of the kinds and quantities of pesticides used.

City Parks and Recreation Departments, These departments were queried about their use of pesticides in public parks, golf courses, etc. and cooperated gladly.

Tree and Lawn Spraying Companies. In each study city, the structure of this business was determined, including the approximate number of individual operators and their relative shares of the total market. The larger operators were contacted and asked for information on the kinds and quantities of pesticides which they purchased and used during 1971. The contractor also asked these experts about the most important ornamental trees and plants, pests affecting them, and pesticide use patterns. Again, the contractor obtained excellent cooperation and much valuable information from the majority of them.

Home and Garden Pesticide Retail Outlets. The contractor determined the most important channels of distribution of home and garden pesticides in each city and visited a representative number of retail outlets to obtain information on the major brands of home and garden pesticides, and on the major products within the different lines.

Nurseries, hardware stores and discount stores are the three principal home and garden pesticide retail outlets. The majority of these, regardless of type, were unable to give meaningful information on the kinds and quantities of different products sold. These stores, in effect, make certain shelf footage or floor space available to each of the major brands stocked. The manufacturer's or distributor's salesmen visit the retailer, usually early in the week and at weekly intervals during the busy season, and restock their respective shelf areas with those products which, in their opinion, will sell best at the particular time. These quantities are then billed centrally, but the billings do not normally come to the attention of the person in charge of the retail home and garden department.

Accordingly, these persons do not know the quantities of the various products they sell, except by general impressions.

Manufacturers of Home and Garden Pesticides. Home and garden pesticides are manufactured and marketed by a relatively small number of large nationwide companies, and by a much larger number of regional and local enterprises. Several of the large companies were contacted in the course of this study. They were most helpful and cooperative in supplying product manuals, price lists, sample labels, leads to further sources of information, etc. In addition, they furnished some quantitative information on their own products which was very useful as a means of cross-checking the estimates which, of course, include the entire market. These manufacturers' products make up only a portion of the total market; this portion varying considerably between the three study cities.

Suburban Residents. Suburban gardeners undoubtedly dispense far greater quantities of pesticides than the public agencies and commercial tree and lawn sprayers combined. To estimate their pesticide uses was therefore very important, and by far the most difficult part of the assignment.

The contractor made door-to-door calls to determine the kinds and quantities of home and garden pesticides used. In addition, garden clubs and similar organizations were contacted in each city, familiarized with the purpose of this study and their cooperation enlisted. In each city, the leaders and members of these organizations were most helpful and assisted the contractor in obtaining responses to the survey questions from their members, neighbors and other qualified respondents. Copies of the questionnaire used and an explanatory statement prepared for these groups are attached as Exhibits A and B.

The individual survey forms were tabulated for each city by major individual products and by property value categories. By comparing the individual survey responses with the information from all other sources, especially the canvass of home and garden pesticide retail outlets, the composition of the average home owner's pesticide shopping list and expenses were determined. Also tabulated were responses on the equipment used to apply these materials, and the outlets where home owners purchase them, and unstructured comments which were offered by respondents. This data base was then further analyzed (for each study city) to determine the amounts of pesticide active ingredients contained in $100 worth of formulated products purchased.

Figures from the sample of respondents from all single family dwelling units, stratified by property valuation, determined the resultant total dollar amounts into pounds of pesticide active ingredients.

It is obvious that estimates obtained by such a series of approximations, including extrapolation from very small samples to very large "universes" cannot claim a high degree of accuracy. However, the contractor's approach and the following statements have to be viewed from the base of no information whatsoever on home and garden pesticide consumption. The contractor believes --

--that the survey and information gathering methods which were employed in this study are novel and useful;

--that the survey results represent a first advance into an unknown area in which information is badly needed;

--and that the following estimates of the kinds and quantities of home and garden pesticides used in the three study areas provide "scope of magnitude' information on the annual pesticide inputs into these suburban lands.

Exhibit "A"

R v R CONSULTANTS
P. O. BOX 553 SHAWNEE MISSION, KANSAS 66201
TELEPHONE 913/722-5795

ROSMARIE VON RÜMKER, SC. D.

HOME AND GARDEN PESTICIDE SURVEY.

Name: ____________________ Address ___________________________________

Name of Product (if known)	Number of times used per year	Problem				Where				Type of Product							How Applied				
		Weeds	Insects	Diseases	Other	Lawn	Roses, Flowers	Shrubs, Trees	Indoors	Fertilizer Mix	Liquid	Spray Powder	Dust	Granules	Systemic	Aerosol Spray	Spreader	Hose-End-Sprayer	Tank Sprayer	Duster	Dispense from container

Money spent per year on all above products (check one):
Less than $5__ $5-10__ $10-15__ $15-20__ $20-25__ $25-30__ $__

Products were purchased at (check one or more):
Nursery__ Discount store__ Hardware store__ Other__

Value of property (check one):
Less than $10,000__ $10-20,000__ $20-50,000__ Above $50,000__

Effects on environment (sick or dead birds, fish, pets, etc., other effects), complaints, other comments:

Interviewer ____________________________________ Date ________________

Exhibit "B"

RvR CONSULTANTS
P. O. BOX 553 SHAWNEE MISSION, KANSAS 66201
TELEPHONE 913/722-5795

ROSMARIE VON RÜMKER, SC. D.

November 1, 1971

HOME AND GARDEN PESTICIDE SURVEY:

The purpose of this study is to obtain information on the total quantity of chemical pesticides (including insecticides, weed-killers, fungicides, etc.) used annually in suburban homes and gardens in three metropolitan areas, namely Philadelphia, Pa.; Dallas, Texas; and Lansing, Michigan. This study is funded by the Environmental Protection Agency under contract No. 68-01-0119; its over-all purpose is to assess the impact of pesticides on the environment. The starting base for such an assessment is the quantitative pesticide input. The attached simple question form is designed to obtain this information.

We are asking for the address of each residence in order to be able to enter the origin of all completed forms on a map of each study area. Following name and address, please enter the name of each pesticide product used per year. A typical entry might look as follows: "Name of product" - Scotts Plus 2;"1"in column "number of times used per year"; check weeds; lawn; fertilizer mix; and spreader. Another typical example might be "Isotox", used "3" times per year; insects; roses, flowers; shrubs, trees; liquid; hose-end sprayer. Please include all pesticide-fertilizer mixes, but do not include straight fertilizers.

Concerning the amount of money spent per year on all pesticides, many people cannot name a single figure right off-hand. However, if you guide them by first asking whether the amount would be more or less than, say, $10, and then take it from there until the right bracket is reached, a good answer can usually be obtained.

The information on where the product(s) were purchased is needed because we are also surveying the retail home and garden pesticide outlets. This is an important cross-check possibility. We are asking for an estimate -in very broad brackets- of the valuation of each property to allow analysis and extrapolation of the data by use of 1970 census information.

We are very grateful for your interest in this project. As you can see, we have much ground to cover in a short time; we need all completed forms by the end of November, sooner if possible. Your assistance will contribute much to making the survey more complete. Please mail all completed forms to the above address at Shawnee Mission, Kansas and indicate your direct expenses, such as postage and/or envelopes, which we will gladly reimburse.

Rosmarie v Rümker

Dr. Rosmarie von Rümker
Project Leader

RvR:fh

Survey Results for Philadelphia, Pennsylvania

General Description of the Area. Philadelphia was chosen as representative of a large metropolitan area and the Middle Atlantic United States.

Area sources contacted by the contractor included Pennsylvania State University's Area Environmental Agent, who furnished literature, information on the area and further sources; and the Pennsylvania Horticultural Society, which conducted a mail survey of a cross-section of its area membership.

The Philadelphia study area consisted of the metropolitan region, including the five Pennsylvania counties of Bucks, Chester, Delaware, Montgomery and Philadelphia. The area has a population of about 3.9 million and contains 879,413 single-family dwelling units. Philadelphia is one of the oldest cities in the United States and has a higher percentage of older suburban homes. The terrain is quite hilly in many of the suburbs, especially on the western side, and many lots are wooded. For these reasons, and the favorable growing conditions present for large shade trees, the average lawn area per residence is probably somewhat smaller in Philadelphia than in many other cities.

Located within the five-county study area is 3,800-acre Fairmount Park, acclaimed as one of the largest and most beautiful city parks in the world. It is made up of rolling woodlands, meadows and hills, and offers nearly every form of outdoor recreation. There are a total of about 90 golf courses within the study area.

Plants, Pests, Pesticides. Table 1 gives an overview of the dominant lawn and garden plants; the insects, diseases and weeds affecting them; and the major pesticides employed within the Philadelphia area. A considerable variety of shade trees, shrubs and evergreens are grown in this city. The climate favors scales, and these appear to be affecting almost all the woody plants. Oil sprays are used widely, with dimethoate frequently reported as an effective insecticide against scales and other insect pests of trees and shrubs. Other insecticides used on trees and shrubs include carbaryl, malathion and methoxychlor.

Roses and other perennial flowers are grown by many Philadelphia suburbanites, although some wooded areas lack sufficient sunlight for these plants.

Annual flowers are grown quite abundantly, but do not generally require or receive insecticide or fungicide treatments.

Bluegrass is the predominant lawn grass species.

TABLE 1

MOST IMPORTANT LAWN & GARDEN PLANTS, PESTS AND PESTICIDES
PHILADELPHIA, PA.

Plants	Insects, Diseases, Weeds	Pesticides
Deciduous Trees		
oak	scales,caterpillar,aphids,mites, borers	malathion methoxychlor carbaryl dimethoate lindane oil sprays
maple	scales,aphids,tent caterpillar, boxelder bug	
birch	leafminer,borer,aphids	
ash	scales,webworm,borer	
magnolia	scales	
mimosa	mimosa webworm	
honeylocust	mimosa webworm,scales	
dogwood	scales,borer	
poplar	scales,borer	
Deciduous Shrubs		
azalea	scales,mites,lacebug	oil sprays dimethoate malathion
lilac	scales,borer	
Pyracantha	scales,aphids	
Evergreen Trees and Shrubs		
juniper	scales,mites,bagworms	malathion methoxychlor carbaryl
yew	scales	
Euonymus	scales	
holly	scales,leafminers,mites	
fir	aphids	
pine	scales,aphids,sawflies,weevil	
spruce	scales,mites,gall aphid,weevil	
Perennial Flowers		
roses	aphids,rose chafers,Jap. beetle adults,leafhoppers,black spot, powdery mildew	malathion, carbaryl,maneb, dinocap,folpet
chrysanthemums	aphids,thrips,leaf spot, powdery mildew	malathion, ferbam
tulips	Botrytis blight	zineb, ferbam
phlox	leaf spot	ferbam
Annual Flowers Vegetables	No major problems requiring routine or extensive pesticide treatments	
Lawn		
lawngrass: bluegrass zoysia	Insects: white grubs (incl. Jap. beetle),chinchbugs,sod webworms	chlordane, carbaryl, diazinon,Aspon
	Diseases: leaf-spot,dollar spot, brown patch	Dyrene,maneb
	Weeds: crabgrass,dandelion	phenoxy herbicides,dicamba-phenoxy combinations

* * * * * * *

HOUSEHOLD PESTS & INSECTS AFFECTING MAN
PHILADELPHIA, PA.

Host	Pests	Pesticides
Man	mosquitoes	Abate,fenthion, oil
	houseflies	household aerosols
	wasps,hornets	lindane,pyrethrum
	blackflies	no chemical recommended
Structures	carpenter ants,termites, millipedes	chlordane,dieldrin

There is some zoysia grass. Lawn insects, diseases and weeds are present, but not to the extent that they will completely destroy lawns if uncontrolled.

Mosquitoes and flies are ubiquitous. Many people complained that wasps and hornets were a particularly bad problem in 1971. Carpenter ants and termites feed on structures in the area.

Table 2 summarizes the estimated total consumption of pesticide active ingredients for suburban pest control activities, broken down by home owners, commercial tree sprayers, golf courses, city parks and mosquito abatement activities. Pesticides are broken down by phenoxy herbicides and other herbicides; malathion, chlordane, dicofol, dimethoate, methoxychlor, and other insecticides; and fungicides.

Home Owner Pesticide Use. Home owners used far greater quantities of home and garden pesticides than all other users combined. In the Philadelphia area, residents have a choice of a bewildering variety of brands, formulations, package sizes and devices, containing single or multiple active ingredients, many of them competing for the same or overlapping purposes. Fertilizer-pesticide mixtures and, to a lesser extent, pesticides on inert

TABLE 2

ESTIMATED QUANTITIES OF HOME & GARDEN PESTICIDES USED IN PHILADELPHIA, PA. SUBURBS, 1971
(Lbs. of Active Ingredient)

Pesticides →	Herbicides		Insecticides						Fungicides
User Group ↓	phenoxy-type	other herbicices	chlordane	dicofol	methoxychlor	malathion	dimethoate	other insecticides	
Homeowners	79,000	10,000	50,000	10,000	(1)	95,000	11,500	32,000	46,000
Commercial Sprayers	negl.	negl.	640	500	1,600	7,000	3,700	14,000	4,200
Golf Courses	(2)	3,600	3,600	(1)	(1)	(1)	(1)	1,000	40,000
City Parks	-	-	-	-	-	100	200	600	-
Mosquito Abatement	-	-	-	-	-	2,300	-	700	-
Totals	79,000	13,600	54,240	10,500	1,600	104,400	15,400	48,300	90,200

(1) Included in "Other Insecticides"
(2) Included in "Other Herbicides"

granular carrier materials which are applied by spreaders are popular.

Commercial Tree and Lawn Spraying. The contractor estimates about 25 - 30% of the market in the greater Philadelphia area residential tree spraying business is dominated by two major companies. Both of them were interviewed; also three other companies of somewhat smaller size. The five companies interviewed account for approximately 40% of this business. The information obtained from them was extrapolated to obtain the entire pesticide input from this source.

The percentage of home owners who engage commercial tree sprayers varies considerably in different parts of Philadelphia. One company estimated that in the western suburbs, as many as 70% of the owners engage commercial sprayers. The same person estimated that a comparable figure for other suburbs would be less than 10%. An operator in the northern suburbs estimated less than 1% of area residents engage commercial sprayers.

Of the 194 respondents included in the home owner survey, 21 (11%) reported that they engaged commercial tree sprayers. The contractor believes that the citywide average is much lower than this.

Golf Courses. There are five public golf courses within the study area. An exact inventory of the quantities of pesticides used on these courses was obtained from the City Parks Department. It was estimated that about 90 golf courses are located within the five-county area, and the estimated quantities were obtained for all golf courses by extrapolating from the city figures. These estimates are probably low because, in all likelihood, private golf courses have higher pest control budgets than the public ones.

City Parks. As mentioned earlier, the Philadelphia study area includes Fairmount Park. The City Parks and Recreation Department estimated that 25% of the pesticides they use are applied in Fairmount Park, 75% in city streets. The quantities reported for "city parks" in Table 2 include both categories. This department uses practically no herbicides or fungicides.

Insects sprayed in street and park trees are the tussock moth, bagworms, tent caterpillars and scales. Spraying for control of the Dutch elms' disease vector has been discontinued completely because of lack of funds. Some dead elm trees remain uncut.

Many of the elms in the center city have been replaced with Gingko trees. This is a botanically very ancient species of tree, which is remarkably resistant against city smog, car and industrial fumes and other forms of city pollution.

Area-Wide Insect Control Programs. Mosquitoes: Mosquito control practices and programs in the Philadelphia area have changed considerably during the last ten years. In the past, DDT was used as the prime mosquito control in all five counties. Three of these, Chester, Bucks and Montgomery, did not conduct any mosquito control work in 1971.

Philadelphia City also relied primarily on DDT in the past. DDT and other products were used for adult mosquito control through fogging devices in residential areas. This activity has been discontinued in response to an increasing number of complaints from residents and DDT is no longer used anywhere.

Mosquito control efforts now focus on control of larvae. Flit MLO larvicidal oil is used extensively, also granular formulations of organic phosphate insecticides. The city has approximately 100,000 "catch basins" which catch rain and storm run-off. Most of them are directly connected with the sewer system. These catch basins are ideal mosquito breeding grounds. City crews are currently suspending dichlorvos resin strips from staples or wires strung through staples above the water surface in these underground basins. These strips remain effective for about two years and offer very economical and effective mosquito control, except for the high labor costs for installation. Where the strips have not yet been mounted, insecticide granules are sometimes used as a stop-gap measure.

Mosquito adults are controlled by fogging only as specifically requested in connection with public events outdoors, but not in residential areas.

Delaware County also conducts mosquito control activities, employing the same procedures as Philadelphia City. They also use Flit MLO larvicidal oil extensively, along with some granules and some liquid and oil formulations of several organic phosphate and carbamate insecticides.

The Delaware County mosquito control crews were kept in service about five weeks longer in 1971 than usual because of the need to spray for mosquito control in Chester County, which suffered severe floods in September following a hurricane.

No chlorinated hydrocarbon insecticides are employed by Philadelphia City or Delaware County in their mosquito control programs. Officials of both agencies anticipated mosquitoes will become a much greater problem in this area than they were during the last decade. They were unable to answer the question as to how this might affect their methods of mosquito control and the extent of control in the future. They felt the public would eventually have to make a choice between mosquitoes and pesticides.

Gypsy Moth: This insect, which is spreading in certain areas in the northeast, is not yet a serious prolem in the Philadelphia area. It has begun to show up in the northern suburbs, especially in Bucks County. If and when gypsy moth control should become necessary, carbaryl will be the product of choice, probably in combination with pinolene. Biological methods for control of the gypsy moth have been tried by various Federal and state agencies, but no promising practical results have been obtained to date.

In summary, home and garden pesticides in the Philadelphia area are used primarily against weeds and, to a lesser extent, insects and diseases on lawns and turf. Ornamental trees and shrubs receive insecticide treatments for the control of scales and other insects. Pesticides are also used for the control of diseases and insects on roses and other perennials, and against mosquitoes, wasps and hornets. Major quantities of DDT were used in the past on elms. The use of DDT has been discontinued completely, and elm spraying has largely been abandoned.

Survey Results for Dallas, Texas

General Description of the Area. Dallas was included in this survey as representative of a large metropolitan area which has grown very rapidly in the last 10 to 15 years, and of the mid-south.

The Dallas study area consisted of Dallas County, including the City of Dallas. The total population is approximately 1,300,000, containing 307,775 single family dwelling units.

The Dallas County terrain is flat, with only some lots having gentle slopes. In the suburbs, there are relatively few large shade trees and many subdivisions do not permit garages and driveways at the front of homes. Alleys run between two parallel rows of houses, with garages and driveways opening on to them. This configuration takes up a considerable portion of back yard space, and swimming pools sometimes reduce this area even further. As a result, lawn areas in relation to total lot size tend to be smaller in the Dallas area than in areas farther north.

Plants, Pests, Pesticides. Table 3 summarizes the most important lawn and garden plants, pests and pesticides in the Dallas area. Elms and pecans probably receive more pesticide treatment than other deciduous trees. The elm leaf beetle has become a major problem in recent

TABLE 3

MOST IMPORTANT LAWN & GARDEN PLANTS, PESTS AND PESTICIDES

DALLAS, TEXAS

Plants	Insects, Diseases, Weeds	Pesticides
Deciduous Trees		
fruitless mulberry sycamore	no major insects, some foliar diseases	not used in significant amounts
oaks (several species)	no major problems	
elms (esp. Chinese)	elm leaf bettle	carbaryl > malathion, diazinon
pecan	aphid, webworms, nut case bearers, scab, powdery mildew	carbaryl, malathion cycloheximide, dodine, thiram
Arizona ash	borers	lindane
Shrubs (no distinction here between deciduous and evergreens because many species deciduous in the North are semi- or wholly evergreen in Dallas)		
wax ligustrum (50% of all shrubs)	no bad problems	not used in significant amounts
holly (30% of all shrubs)	no bad problems	
pyracantha	lace bugs, aphids	
gardenia	no bad problems	
boxwood	no bad problems	
crepe myrtle	powdery mildew	
loquat	no bad problems	
junipers	bagworms	
Euonymus	scales, aphids, whiteflies	
Perennial Flowers		
roses	aphids, mites black spot, powdery mildew	insecticide mixtures folpet, benomyl, insecticide-fungicide combinations
Annual Flowers		
petunias, pansies zinnias, marigold	very short season, no severe problems	not used in significant amounts
Vegetables		
tomatoes	few suburbanites grow vegetables	
Lawn grasses	Insects: white grubs, chinchbugs (not on Bermuda)	diazinon, dieldrin, chlordane
St. Augustine 80% Bermuda 20%	armyworms	carbaryl, insecticide mixtures
no bluegrass	Diseases: brown patch	PCNB > Daconil, Consan 20 (benzyl ammonium chloride)
	Weeds: broadleaves	atrazine (Bermuda intolerant) 2,4-D (St. Augustine intolerant), dicamba
	grasses (difficult to control with chemicals)	MSMA

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TABLE 3
Continued

HOUSEHOLD PESTS AND INSECTS AFFECTING MAN
DALLAS, TEXAS

Host	Pests	Pesticides
man	mosquitoes	Have not been problem last two years due to prolonged drought.
structures, stored products	roaches, earwigs crickets, houseflies	aerosol sprays professional exterminators
	termites	professional exterminators

years, especially on Chinese elm. Pecans are popular shade trees in the area, and are affected by a number of different insects, as well as powdery mildew.

There are very few evergreen coniferous trees in this area. Many shrubs which are deciduous in the northern parts of the United States are evergreen here; for this reason, no distinction has been made between deciduous and evergreen shrubs in Table 3. Most of the shrubs grown in foundation plantings are very well suited to the area and generally do not require a lot of pesticides.

Roses are grown in the area to some extent, but not as abundantly as in other cities. As elsewhere, they have their usual disease problems, i.e., blackspot and powdery mildew, and Aphids and mites are among the insect problems.

Annual flowers have a very short growing season in the Dallas area and usually do not have severe insect or disease problems requiring chemical treatment. Very few Dallas suburbanites have vegetable plantings and consequently, this is not a major source of pesticide consumption.

The present population of lawn grasses consists of about 80% St. Augustine, 20% Bermuda. St. Augustine grass was used almost exclusively in this area until about 1965.

Since that time, it has been increasingly affected by the destructive "St. Augustine decline" disease. At the same time, several improved Bermuda grass hybrids were developed, which now account for the great majority of new plantings. There is no blue grass in this area.

Almost all lawns require irrigation. Many residences, especially in the upper valuation brackets, have automatic sprinklers.

White grubs (12 or more different insect species) and chinch bugs are the worst lawn problems. They can be quite devastating and have developed a considerable degree of resistance to chlorinated hydrocarbon insecticides. When this is the case, diazinon is currently the product of choice. Last fall, Dallas lawns were invaded by armyworms which were controlled by carbaryl and other insecticides, including several combination products.

St. Augustine and Bermuda grasses are rather resistant to fungus diseases and consequently home owners do not use lawn fungicides to any great extent. Fertilizer-pesticide combination products containing a fungicide component are used.

St. Augustine and Bermuda grasses are quite aggressive and effectively compete with weeds. Consequently, lawn weeds are not as much of a problem in Dallas as in other areas. Phenoxy-type herbicides are used in small quantities here since St. Augustine grass is quite sensitive to them.

Mosquitoes have not been a problem in the Dallas area for the last two years because of a prolonged drought. However, roaches, earwigs, crickets, houseflies, termites and other insects feeding on structures and stored products are a year-round problem. Insecticide aerosols are used quite heavily and many residents employ professional exterminators regularly.

Table 4 summarizes the estimated total suburban consumption of pesticide-active ingredients in the Dallas area.

Home Owner Pesticide Use. As in the other study cities, there is a large assortment of home and garden pesticides designed for home owner use. In addition to a number of nationally distributed brands, several Texas-based product lines are sold here.

Fertilizer-pesticide mixtures and pesticides in dry inert granular carriers are quite popular both alone and in combination with other active ingredients. Several insecticide spray products still contain DDT, usually in

TABLE 4

ESTIMATED QUANTITIES OF HOME & GARDEN PESTICIDES USED IN DALLAS, TEXAS SUBURBS, 1971
(Lbs. of Active Ingredient)

Pesticides →	Herbicides				Insecticides						
User Group ↓	phenoxy-type	dicamba	atrazine	other herbicides	chlordane	dieldrin	carbaryl	malathion	diazinon	other insecticides	Fungicides
Homeowners	10,500	3,500	3,500	3,000	35,000	11,000	15,500	57,500	24,000	73,000	20,000
Commercial Sprayers	← negligible →				1,000	2,000	3,000	3,000	4,000	6,000	2,500
Golf Courses	100	(1)	(1)	2,000	3,000	1,000	800	800	1,000	1,000	3,000
City Programs	← negligible →				(2)	(2)	(2)	5,000	2,000	2,500	negl.
Totals	10,600	3,500	3,500	5,000	39,000	14,000	19,300	66,300	31,000	82,500	26,000

(1) Included in "other herbicides"

(2) Included in "other insecticides"

combination with other insecticide active ingredients.

The assortment of chemicals used by Dallas home owners reflects the heavy use of insecticides on lawns, and the relatively lesser importance of weeds and diseases. Sprayable products containing insecticide or insecticide-fungicide combinations are popular for use on shrubs and flowers.

The ornamental horticulture specialist in the office of the Dallas County Agent, Texas A & M University Agricultural Extension Service, reported receiving about 14,000 calls from Dallas area residents each year. Almost 80% of these calls involve insect and disease problems on ornamental plants with the specific problems varying with the season. This past year, grub worms and armyworms on lawns, and pecan scab were among the main problems. Only about 30 calls pertain to roses. Several hundred complaints were reported last year involving injury to lawns or shrubs from the use of herbicide-fertilizer combinations. Products containing atrazine as an active ingredient were involved in 95% of these cases.

Commercial Tree and Lawn Sprayers. Area experts vary considerably in their opinions of the percentage of suburban residents in the Dallas area engaging commercial sprayers. It is estimated that up to 30% of those home owners in the highest valuation brackets contract for outdoor pest control; this estimate holds for approximately 8 to 10% in the $20 to $50,000 valuation bracket, and less than 1% in lower brackets. In the contractor's survey of Dallas home owners, 7 out of 164 (4%) reported engaging commercial sprayers.

The commercial market in Dallas is composed of many different lawn and tree service firms, with nurseries, exterminators, and individuals also offering spraying services.

Home owners engage commercial sprayers primarily for two purposes: control of insects and diseases on trees, and control of lawn insects.

Golf Courses. There are five city golf courses in the Dallas study area. The Contractor obtained the pesticide use inventories for these golf courses from the Parks and Recreation Department, and, with these figures as a basis, estimated the pesticides used on the fifty public/private courses in the area. Protection of lawn grasses from insects, diseases, and, to a lesser extent, weeds are the main pesticide uses on golf courses.

Other City Programs. In addition to the use of pesticides on golf courses, the Dallas City Government purchases pesticides for use by the Parks, Health, Public Works and Water Departments. All pesticides used by these city agencies as reported by the city purchasing department were combined under the category "City Programs" in Table 4.

Area-Wide Insect Control Programs. As far as can be determined, no area-wide insect control programs or other activities involving area-wide distribution of pesticides by public agencies were conducted in the Dallas area during the last two years. As mentioned above, mosquitoes have not been a problem due to a prolonged drought.

Table 4 shows the major problem areas for which pesticides are used in the Dallas area. Lawn problems rank as first on the list, and far outdistance insects, tree and shrub disease, and lawn weeds. Lawn weeds are a relatively small problem in this area due to the combination of aggressive, well adapted lawn grasses, and low rainfall. The considerable quantity of herbicides applied in this area is partially due to skillful selling of fertilizer-herbicide mixtures. In many instances, blanketing lawns with herbicides is probably not necessary.

Survey Results for Lansing, Michigan

General Description of the Area. Lansing was chosen as representative of a smaller metropolitan area and of the upper Midwest. Both the state government and Michigan State University are located here. The State Department of Agriculture, especially the MSU Department of Entomology and the Pesticide Research Center, have been greatly interested in urban and suburban uses of pesticides and their possible effects on environmental quality. The contractor obtained excellent cooperation from these agencies. Although they do not conduct any immediately applicable work, the EPA Pesticide Community Studies Project in the State Department of Public Health was also contacted and provided some advice.

The Lansing study area consists of the "nine township area" which includes the cities of Lansing and East Lansing, and the townships of Lansing, Meridian, Delhi and Alaiedon in Ingham County; Watertown, DeWitt and Bath in Clinton County and Delta and Windsor in Eaton County. The area population is approximately 272,000, and with 56,658 single-family dwellings. Michigan State University campus at East Lansing is included in this area.

The Lansing metropolitan area has grown rapidly in the last two decades, with the population doubling between 1956 and 1966. Many suburban homes are less than ten years old and are surrounded by relatively large lawns. Large shade trees predominate in older suburban subdivisions.

The terrain is generally flat with most lots having only gentle slopes, if any.

Plants, Pests, Pesticides. Table 5 gives an overview of the most important lawn and garden plants, pests and pesticides in the Lansing area.

As in many eastern and midwestern cities, elms have been the predominant street and shade trees: however, they are rapidly falling victim to the Dutch elm disease. Maples, oaks, honey-locusts, birches and other trees have been planted more recently. Deciduous shrubs and evergreen trees and shrubs do very well in this region of the country and are abundant in the Lansing suburbs. They also attract numerous insect pests; however, these generally are not severe infestations and do not require heavy insecticide use.

Roses grow very well in this area and are grown with enthusiasm by many suburbanites. Many people apply fungicides for control of blackspot and, to a lesser extent, powdery mildew. Insecticides are used on roses against mites, aphids, chafers and beetles.

Annual flowers in this area rarely require or receive pesticide treatments. Not many residents have vegetable gardens and consequently, there is no significant use of pesticides for this purpose either.

TABLE 5

MOST IMPORTANT LAWN & GARDEN PLANTS, PESTS AND PESTICIDES
LANSING, MICHIGAN

Plants	Insects, Diseases, Weeds	Pesticides
Deciduous Trees		
elm (dying out)	elm bark beetles, Dutch elm disease; scales, aphids	methoxychlor
maple (sugar, Norway)	scales, aphids, mites	malathion carbaryl
oak	scales, fall webworms, galls	
birch	birch leafminer, aphids bronze birch borer	
locust (honey)	mites, pod galls, leafhoppers	
willow	aphids, willow leaf beetle	
flowering crab	aphids, scales, webworms, cankerworms	
sycamore	lacebugs, scales	
	anthracnose	zineb, Cu-cpds.
Deciduous Shrubs		
forsythia	mites	malathion, insecticide mixtures
honeysuckle	mites	
cotoneaster	aphids, mites, scales	
Euonymus	scales, aphids, black vine weevil	
Viburnum	aphids, plant bugs	
all shrubs	powdery mildew	rarely sprayed
Evergreen Trees and Shrubs		
yew	scales, black vine weevil	malathion, carbaryl
juniper	scales, webworms, mites	
arborvitae	leafminer, mites, scales, bagworms	
fir	gall aphid, other aphids	
pine	scales, mites, sawflies, moths, aphids	
spruce	scales, mites, gall aphids	
Perennial Flowers		
roses	blackspot > powdery mildew	folpet, benomyl
	mites, aphids, chafers, beetles	malathion, insecticide mixtures
chrysanthemums	gall midge	
peonies	aphids	
gladiolus	aphids	
	European corn borer	methoxychlor, carbaryl
Annual Flowers		
various	rarely require or receive pesticide treatments	
Vegetables		
tomatoes	hornworm, flea beetles	carbaryl
beans	Colorado potato beetle	carbaryl
radishes, carrots	maggots	diazinon

TABLE 5
Continued

Plants	Insects, Diseases, Weeds	Pesticides
Lawn grasses	Insects: white grubs, moles	chlordane
90% bluegrass; some fescue, bent	sod webworm	carbaryl, diazinon
no Zoysia or southern grasses	Diseases: Fusarium striped smut, dollar spot, powdery mildew Helminthosporium	benomyl, cycloheximide, thiram
	Weeds: broadleaves	phenoxy-type dicamba
	grasses difficult to control with chemicals	

* *

HOUSEHOLD PESTS AND INSECTS AFFECTING MAN

LANSING, MICHIGAN

Host	Pests	Pesticides
man	mosquito larvae	Abate, fenthion
	mosquito adults	aerosol sprays, malathion
	houseflies	aerosol sprays, malathion, insecticide mixtures
structures, stored products	carpenter ants, carpet beetles cockroaches, beetles millipedes, centipedes	chlordane, malathion dichlorvos, methoxychlor

More than 90% of the lawns consist of bluegrass varieties. Zoysia or southern types of grasses do not survive the severe Lansing winters. Weeds generally cause more lawn problems than insects or fungus diseases, and consequently, there is sizeable consumption of herbicides.

Mosquitoes are a considerable problem in this area, along with carpenter ants, carpet beetles, cockroaches and several other household pests.

Table 6 summarizes the estimated total suburban consumption of pesticide-active ingredients in the Lansing area.

Home Owner Pesticide Use. Among the herbicides, phenoxy-type products predominate so heavily that other chemicals were not broken out in Table 6. Fertilizer-herbicide mixtures are quite popular. Close to 40% of the total quantity of herbicides used by home owners are applied as fertilizer-herbicide mixtures. Chlordane is used primarily for the control of lawn insects. Foliar insects are controlled by malathion, carbaryl and combination insecticides whose active ingredients are included in the "other insecticides" category. Fungicides are used primarily on roses and, to a lesser extent, as constituents in insecticide-fungicide products.

TABLE 6

ESTIMATED QUANTITIES OF HOME & GARDEN PESTICIDES USED IN LANSING/EAST LANSING, MICHIGAN SUBURBS, 1971

(Lbs. of Active Ingredients)

Pesticides →	Herbicides[1]	Insecticides					Fungicides
User Group ↓		chlordane	methoxychlor	malathion	carbaryl	other insecticides	
Homeowners	12,100	3,500	(2)	3,700	1,700	5,600	2,800
Commercial Sprayers	negl.	negl.	3,300	-	800	550	negl.
Golf Courses	500	(2)	negl.	(2)	(2)	1,000	1,000
Mosquito Abatement	-	-	-	-	-	2,500	-
Totals	12,600	3,500	3,300	3,700	2,500	9,650	3,800

(1) Predominantly phenoxy-type products.

(2) Included in "Other Insecticides".

Commercial Tree Spraying. More than 90% of the residential tree spraying in the Lansing area is done by one company. This company also contracts with the City Parks Departments for the spraying of city trees. On city streets as well as on residential properties, elm trees account for the majority of the spraying. Methoxychlor is presently chosen for control of the vector of the Dutch elm disease, the elm bark beetle. Approximately 3,300 lbs. methoxychlor active ingredient were used for this purpose during the last year. Carbaryl and diazinon (the latter included in the "other insecticides" category) are the insecticides chosen for control of leaf-feeding insects and miners on other trees.

Twelve of 135 responding home owners surveyed, or about 9%, reported engaging commercial sprayers. This figure is supported by estimates from the dominant commercial sprayer. This firm avoids residential lawn spraying when possible and, consequently, uses only negligible amounts of herbicides, insecticides and fungicides for this purpose.

The company also reported investigating as many as 200 trees killed by fertilizer-herbicide mixtures containing the herbicide dicamba. This would indicate either gross carelessness by users of this product, inadequate label directions, or both.

Area-Wide Insect Control Programs. Mosquitoes: Mosquito control activities in the cities of Lansing and East Lansing are carried out by the Parks and Recreation Department of the City of Lansing. Mosquitoes are a considerable problem in this area, and control measures are directed against larvae as well as adults. Insecticides used include Abate, fenthion and malathion. The contractor estimates that a total of 2,500 lbs. of active ingredients of the three chemicals were used in this program.

In spite of this substantial insecticide use, there were a considerable number of citizen complaints about lack of protection from mosquitoes. In general, these complaints come from people who have lived in the area for some time and compare the present mosquito level with that of the past, when chlorinated hydrocarbon insecticides effectively lowered that level.

Elm Bark Beetle: As mentioned above, the older parts of the Lansing metropolitan area have a high elm tree population, and Dutch elm disease is well established there. In the past, DDT was applied extensively to control the disease vector, the elm bark beetle, with 7 to 8,000 pounds or more used annually. However, DDT has been replaced by methoxychlor, of which approximately 3,300 lbs. were used in 1971.

This declining rate of application of methoxychlor is due to the decline in the number of elm trees remaining and budget restrictions. Methoxychlor is approximately twice as expensive as DDT so that with the same budget, only half as many trees can be sprayed with this replacement insecticide, assuming no change in the rate of application.

Gypsy Moth: In the mid or late 1950's, there was a sizeable gypsy moth outbreak in this area. At that time, about 60,000 acres were sprayed with 1 lb DDT active ingredient per acre for several years in succession. The program was considered quite successful at the time, and very good mosquito control was obtained as a side benefit. However, unwanted side effects also began to appear, including low level DDT contamination in milk from area dairies. As a result, carbaryl was substituted in the pastures and other areas adjacent to dairies. DDT was last used against the gypsy moth in about 1962.

A second, smaller but rather intense outbreak of gypsy moths occurred in 1967 in a recreational area about 10 miles south of Lansing. At that time, two applications of carbaryl at 1 lb. of active ingredient per acre each time were made, supplemented by a door-to-door search for, and treatment of gypsy moth egg masses in the affected area. No gypsy moths have been found in the area since 1968.

Japanese Beetle: The area is also subject to Japanese beetle infestations. In the late 50's or early 60's, an infestation on the west side of Lansing was eliminated with area-wide applications of 3 lbs. of dieldrin active ingredient per acre.

The State Department of Agriculture and Lansing city officials who knew of this program emphasized that with present knowledge of persistent pesticides, a blanket application of 3 lbs. of dieldrin active per acre would be unthinkable. Chlordane is presently the only product still available for Japanese beetle control. This product can be used at a maximum of 5 lbs. of active/acre in accordance with guidelines of the Federal Working Group on Pesticides, the group which must approve all federally funded or supported programs of this type. This rate of chlordane is not sufficient for eradication of the Japanese beetle and it will only give some degree of control. It was pointed out that in view of this situation, prospects for halting further spread of the Japanese beetle into Michigan are dim.

Legal Restrictions and Their Enforcement. Michigan has a State Pesticide Law, but home and garden pesticides are not subject to the more stringent requirements such as licensing of retail outlets.

DDT was banned in the state of Michigan two years ago. One year after notification of manufacturers and retail outlets of pesticides registered in the state, including home and garden products, Department of Agriculture inspectors collected, without reimbursement, all inventories of DDT-containing products remaining on retailers' shelves.

At the same time, active environmentalists and area citizens, in cooperation with the Departments of Agriculture and Natural Resources, initiated a collection program of DDT-containing and other pesticides which local residents wished to discard. Some 40,000 lbs. of unwanted chemicals were collected, however, disposal posed a major problem. Eventually, the materials were sorted, segregated, drummed and transported to Midland, Michigan for incineration by Dow Chemical Company. Many of those involved in the program now believe that use of the remaining pesticides would have been a more efficient disposal method.

A considerable number of home and garden retail outlets were visited by the contractor. No DDT-containing pesticides were evident, although some retailers did stock liquid products containing 2,4.5-T, which is federally banned from home and garden use. State officials contacted were aware of this situation, but stated that implementation of the Federal edict was proceeding slowly until all legal proceedings, rebuttals by the manufacturers of these products, etc. are resolved.

Some emulsifiable concentrate formulations containing 2,4,5-T found on retailers' shelves carried the following warning sticker on the top of the can:

> "Notice. The following uses for products containing 2,4,5-T are no longer registered by the U.S. Department of Agriculture: 1-All uses in lakes, ponds, or on ditch banks; 2-Liquid formulations for use around the home, recreation areas and similar sites. Do not apply this product on any of the areas listed above."

Since these stickers were attached to pint containers, stocked in home and garden pesticide retail outlets, this warning sounded a rather unrealistic note.

The total pesticide use pattern for Lansing, as shown in Table 6, mirrors the area's major pest problems: weeds and insects on lawns; the Dutch elm disease - elm bark beetle complex; diseases and insects on roses; foliar insects on ornamental trees and shrubs; and mosquito control. Fungus diseases on lawns and on trees and shrubs are of relatively minor importance.

In the past, the area has received heavy and repeated area-wide applications of chlorinated hydrocarbon insecticides, including DDT for gypsy moth and elm bark beetle control, and dieldrin for Japanese beetle control. In recent years, carbaryl has been substituted for DDT in the control of gypsy moth, and methoxychlor for DDT in the elm care program. Chlordane is the only available replacement for dieldrin for Japanese beetle control, but its effectiveness for this purpose is questionable.

Home and Garden Pesticide Use Patterns. Table 7 summarizes the estimated quantities of pesticides used in homes and gardens in each city. Also included is the total population and the number of single family dwelling units in each study area.

Based on this summary, there appears to be no correlation between the numbers of single family dwellings and the estimated quantities of pesticides used in each area. As pointed out previously, climatic, soil and other environmental conditions vary widely between the three study cities. Types of trees, shrubs and lawn grasses vary equally, as do the pests affecting them. In addition, many man-made factors including the lot size, relative size of lawn area in relation to lot, zoning restrictions, etc. also vary greatly between the three cities. As a result, each area has a distinctly different home and garden pesticide use pattern. For this reason, the contractor does not feel the data presented here could be meaningfully extrapolated to a national level. A number of additional areas representative of conditions not covered in this report would have to be studied before an estimate of the total national home and garden pesticide consumption could be obtained.

TABLE 7

SUMMARY OF POPULATION, SINGLE FAMILY DWELLINGS AND ESTIMATED QUANTITIES OF HOME AND GARDEN PESTICIDES USED IN THE THREE STUDY AREAS, BY PRODUCTS

Study Area	Popu-lation (000)	Single Family Dwellings	Home and Garden Pesticides Used, 000 Lbs. of Active Ingredients																
			Herbicides					Insecticides											
			phenoxy	dicamba	atrazine	other herbicides	All Herbicides	chlordane	dieldrin	dicofol	methoxychlor	dimethoate	carbaryl	malathion	diazinon	other insecticides	All Insecticides	All Fungicides	All Pesticides
Philadelphia	3,866	879,413	79	(1)	(1)	14	93	54	(2)	11	2	15	(2)	104	(2)	48	234	90	417
Dallas	1,327	307,775	11	4	4	5	24	39	14	(2)	(2)	(2)	19	66	31	82	251	26	301
Lansing	272	56,658	13	(3)	(3)	(3)	13	4	(3)	(2)	3	(3)	3	4	(2)	10	24	4	41
Totals	5,465	1,243,846	103	4	4	19	130	97	14	11	5	15	22	174	31	140	509	120	759

(1) Included in "Other Herbicides"
(2) Included in "Other Insecticides"
(3) Negligible

The three study cities have a total population of about 5.5 million and contain about 1,244,000 single family dwelling units. It is estimated that a total of slightly over 750,000 lbs. of pesticide active ingredients are used in this area, consisting of about 130,000 lbs. of herbicides, 510,000 lbs. of insecticides and 120,000 lbs. of fungicides.

Efforts to relate these quantities to the size of the input area are hampered by the lack of land use data for the study areas. Therefore, the contractor attempted to quantify home and garden pesticide use per unit of area at least for the largest use segment, i.e., home owner use on their own properties. It is estimated that in the study area, the average lawn and garden area per residence is somewhere in the range of between 2,000 and 6,000 square feet.

Table 8 presents a computation of the total pesticide burden (in terms of lbs. of active ingredients) per acre of residential lawn and garden area, excluding areas built up or under pavement, assuming an everage of 2, 4, or 6,000 square feet of lawn and garden area per single family housing unit. The total estimated pesticide use by home owners alone (from Tables 2, 4 and 6) in the three cities is 609,400 lbs. of combined active ingredients. In the case of the high estimate, there would be 1,244,000 x 6,000 sq.ft. = 0.138 acres = 172,000 acres,

TABLE 8

RELATIONSHIPS BETWEEN PESTICIDE DEPOSIT AND SIZE OF LAWN AND GARDEN AREA PER SINGLE FAMILY DWELLING UNIT

Assumptions					
Size of Lawn and Garden Area	per S.F.D.[1]	Sq.Ft.	6,000	4,000	2,000
		Acre	0.138	0.092	0.046
	for 1,244,000 S.F.D.'s	Acres	172,000	114,600	57,300
Pesticide Deposit[2]		Lbs. Active Ingredients Per Acre	3.54	5.3	10.6

1 S.F.D. = Single Family Dwelling Unit

2 Assuming total consumption by 1,244,000 S.F.D.s = 605,400 lbs. of pesticide active ingredients.

which would receive an average deposit of 3.5 lbs. of pesticide active ingredients per acre. In the case of the low estimate, the 609,400 lbs. of active ingredients would impact on only 57,300 acres, for an average deposit of 10.6 lbs. of active ingredient per acre.

The contractor believes that the average is between 2,000 and 4,000 sq.ft. of garden area per home, but in the absence of better land use data, it is not realistic to try to pinpoint this estimate. However, these figures indicate much higher amounts of chemicals are applied per acre in home and garden use of pesticides than in agricultural pesticide use. Suburban lawns and gardens probably receive the heaviest applications of pesticides of any land areas in the country.

Home and Garden Pesticide Formulations. There is a bewildering array of home and garden pesticide brands, formulations, and package sizes offered for sale. Some of these product lines are nationally known and marketed, while others are only regionally or locally distributed. A number of products in the latter categories do not have federally registered labels.

The contractor analyzed one typical retailer's assortment in detail. This store carried three different lines of fertilizer-pesticide combination products. Each line offered a variety of straight fertilizers (not included in the analysis or figures below), and a variety of fertilizers combined with one or more herbicides; one or more insecticides; and different insecticide-herbicide mixtures. Some of these are also offered as inert granules, rather than as fertilizer carriers. Among the three brands, there were 30 different products of this type offered for sale, most of them in two or three package sizes.

In the "packaged products" area, the store carried about 20 herbicide products; more than 100 insecticides, including liquids, wettable powders, aerosols, dusts, cartridges, granules, etc.; and some 25 fungicides, again with different choices of formulations. Furthermore, there were about 20 various "multi-purpose" products containing insecticide-fungicide, or "three-way" insecticide-fungicide-herbicide mixtures in various formulations. Repellents and other special items and devices comprised an additional 30 products.

The almost 200 packaged products described above do not include different package sizes. Usually, there are two or three package sizes for each product, so the above figures would have to be multiplied by an average of 2.5, for a total of about 500 different items in the "packaged pesticides" category. Not all retail stores carry all of the above products, but the situation detailed here is fairly typical of the better garden supply stores. The contractor found a still larger number of products in several other places visited.

The total assortment of home and garden pesticides offered in the three study areas contained 50 to 60 different active chemical ingredients, including at least 20 herbicides, 25 insecticides and 10 fungicides. As described above, many formulated products contain combinations of these chemicals to control a wider variety of insects, weeds, or diseases, or to multiply effectiveness, i.e., all conceivable combinations of insect, weed and disease control, plus fertilization, in two, three or four-way mixtures.

Home and Garden Pesticide Use Recommendations. Nurseries, hardware stores and discount stores are the main dispensaries of the plethora of products described above. Most of the better nurseries and garden supply stores strive to sell their customers satisfaction and enjoyment from their gardening activities, rather than just merchandise. Their approach is to analyze a customer's insect, weed or disease problem and recommend the right product for its cure, with proper instructions on its use. This system tends to break down somewhat during rush hours when there are more pesticide customers than trained sales personnel.

Discount stores, on the other hand, usually operate on a self-service system, where the customer must select the right product from among the large selection offered.

Hardware and department stores vary between the two extremes of dispensing advice depending upon the degree of interest and expertise of the store owner or manager of the home and garden department.

In labeling home and garden pesticides, the brand name of the line (example: "Ortho," "Scotts") and the trade name of the product (example: "Isotox," "Halts") are heavily emphasized, while the active ingredient descriptions appear in very fine print. Identification of trade named products with specific chemical active ingredients is further complicated by the fact that manufacturers frequently change the active ingredients in these products without changing the product name or outward appearance.

The only readily available unbiased source of advice at the local level is provided by state university extension services. However, these agencies issue findings and recommendations in terms of common names or chemical names of pesticide active ingredients. Consequently, it is practically impossible for the layman to utilize this source of advice.

Thus, the most important and often the sole source of information on product effectiveness is the manufacturer's literature, including the product label. Most of these items are well written and informative and instruct the customer on proper and safe usage. They are, of course, also intended to sell as much of the product as possible. For instance, a person wishing to find out if he really needs a two-, three-, or four-way combination product has no practical way of getting an unbiased answer.

Home and Garden Pesticide Application Techniques. Home Owners: Table 9 summarizes the responses of home owners on equipment for applying liquid pesticides. Of a total of 493 respondents, 38% reported using hose-end sprayers, while 30% used tank sprayers. Hose-end sprayers which have come into use rather recently were reported in greater use in Dallas and Lansing, which have young suburbs, while Philadelphia, with older suburbs, reported a predominance of tank sprayers.

Fertilizer spreaders were also included in the survey but not tabulated; most suburban gardeners have

TABLE 9

HOME OWNERS' EQUIPMENT FOR APPLYING LIQUID PESTICIDES

Study City	# Survey Respondents	Hose end Sprayers		Tank Sprayers		Otner Devices	
		#	%[1]	#	%[1]	#	%[1]
Philadelphia	194	54	28	83	43	3	2
Dallas	164	81	49	29	18	2	1
Lansing	135	53	40	36	27	2	1
Totals	493	188	38	148	30	7	1

[1] Percentage figures do not total up to 100 because many respondents did not have any hose-end sprayers, tank sprayers or other devices for dispensing liquid pesticides. Some had two or all three types.

or borrow spreaders when they wish to apply dry fertilizers and/or dry granular pesticides.

The "other devices" reported included sprinkling cans, used mainly for application of total herbicides on driveways, walkways, etc., and dusters, although the greatest amount of home and garden pesticide dusts are dispensed directly from the container. All outdoor, indoor, and "universal" pesticide aerosols are dispensed directly from the container.

Almost all empty home and garden pesticide containers are deposited in the trash. Some users did admit to rinsing pesticide containers or equipment in the sink, while others said they had flushed liquids in either concentrate or dilute form down the drain or toilet. It is suspected that more people utilize these latter practices than are willing to admit.

Professional Operators: The most common type of pesticide application equipment used by commercial tree and lawn sprayers as well as by public agencies is the hydraulic tank sprayer. Various fogging devices are also in use in mosquito control programs, but their use appears to have declined in the study areas.

Formulation and Application Techniques in Relation to Pollution Potential. In the following discussion, pollution potential is defined as the likelihood of pesticide particles or residues to move from the site of application and pollute the environment out of the target area.

The use of dry granular-type home and garden pesticides has increased considerably in recent years. These granular products often contain plant nutrients, and are applied by fertilizer spreaders. The increasing popularity of this application technique is a positive factor from the standpoint of environmental pollution potential. With the dry, granular-type pesticides, there is no drift, and the granules tend to be more resistant to transport by run-off or leaching. On the other hand, the development and aggressive selling of multi-purpose granular products tend to encourage unnecessary use of pesticides.

Application of liquid insecticides to lawns and turf probably has a higher potential for environmental pollution than most other practices. These products are often emulsifiable concentrates containing high percentages of an active ingredient. For example, an emulsifiable spray concentrate containing 74% technical chlordane is recommended for the control of lawn insects at the rate of 1/2 pint per 2,400 sq.ft., which is equivalent to about 9 lbs. active/acre. If this application to a lawn is followed by heavy rainfall soon afterward, heavy run-off is a definite possibility, with the amount of run-off depending upon the amount and intensity of precipitation, how soon after application it occurs, the slope of the treated area, as well as other factors.

In principle, spray applications of herbicides and fungicides to lawns are subject to the same considerations, although these products are generally used at lower rates of application per treated area. Furthermore, many herbicides act systematically and are taken up and into treated plants rather rapidly, preventing movement from the application site.

The pollution potential of tree spraying depends primarily upon the application equipment. Considerable spray drift occurs from high pressure hydraulic sprayers, and can travel over considerable distances, depending upon spray particle size, wind velocity and other factors. Run-off from treated foliage may also occur during or after application, especially if rain follows. A high percentage of run-off from trees growing in paved areas will go directly into sewer systems. However, most run-off from trees growing in unpaved areas will be adsorbed and retained on surrounding soil or vegetation thereby reducing pollution potential.

Insecticide or fungicide sprays applied with hose-end or small tank sprayers have a lower pollution potential. These devices operate with low pressure, producing rather large droplets which are not prone to drift. Run-off from treated plants during or after application will be caught and held by nearby soil or lawn. Home and garden pesticide dusts or aerosols present an even lower pollution potential since they contain very low percentages of active ingredients, and are quite expensive in terms of the active ingredient contained. When used in excess, dust formulations also leave unsightly deposits which is another deterrent to overuse.

It is believed that liquid insecticide sprays and the use of pesticides on trees growing in pavement present the greatest pollution potentials among suburban pesticide use patterns.

Timing is an important consideration determining this pollution potential. It is estimated that in Philadelphia and Lansing, 80 to 90% of all lawn and garden pesticides are applied annually between April 25 and June 10. Within this period, the majority of all materials are applied on Saturdays. Therefore, a rainfall on immediately subsequent days could result in considerable pesticide run-off.

In Dallas, there is a dintinct peak in pesticide use during the spring, followed by a second, smaller peak in the fall.

Home Owners' Attitudes on Pesticides and Observations on Environmental Effects. Home owners were questioned by the contractor on the "effects on environment (sick or dead birds, fish, pets, etc., other effects), complaints, other comments ," from pesticides. Table 10 summarizes the replies of the 525 respondents.

No major variations in responses appeared between the three cities. Of the respondents, 92.5% reported using pesticides; 84% did not indicate any reservations about using pesticides while 8.5% did indicate concern about side effects, commenting that they used pesticides sparingly, or only as a last resort. The latter group included persons who attempted organic gardening, but used pesticides where organic methods had not succeeded. Seven and one-half per cent of all respondents reported they used no pesticides at all. Two and one-half per cent cited organic gardening as the reason, while five per cent gave various reasons, including allergies to chemicals.

TABLE 10

HOME OWNERS' ATTITUDES ON PESTICIDES AND OBSERVATIONS OF ENVIRONMENTAL EFFECTS

City	Philadelphia	Dallas	Lansing	All Respondents
Number of Respondents	194	196	135	525
Use Pesticides?				
Yes	91%	93.0%	94.0%	92.5%
- without reservations	80	86.0	83.5	84.0
- with reservations(1)	11	7.0	7.5	8.5
No	9	7.0	6.0	7.5
- garden organically	4	2.5	1.5	2.5
- other reasons (2)	5	4.5	4.5	5.0
Notice adverse effects on environment from use of pesticides?				
Yes (3)	5	3.5	1.5	3.5
No	60	31.0	35.0	43.0
No Reply	35	65.5	63.5	53.5

(1) Use pesticides very sparingly, only as a last resort; use pesticides, but concerned about side effects; try to garden organically.
(2) Allergies to chemicals, other, or no specific reasons.
(3) Believe birds, bees diminishing from pesticide use; believe pets became sick from pesticides, etc.

When questioned on the adverse environmental effects from the use of home and garden pesticides, 43% of all respondents said they had not observed any such effects, with the most frequent reply being "none that I know of." Three and one-half per cent answered affirmatively, indicating they believed birds, bees, etc. were diminishing and/or pets became sick from the use of pesticides around the house. 53.5% did not specifically reply to the question. These responses appear to indicate that a majority of those contacted are not greatly concerned about home and garden pesticides from an environmental standpoint.

The contractor did not receive any reports of adverse effects on human health from the use of home and garden pesticides by the 525 respondents. There were eight reports (1.5%) of actual or feared allergies to pesticides. Thus, the great majority of suburbanites participating in this survey considered home and garden pesticides safe for use.

At the same time, many of these people objected to area-wide pesticide application activities. These feelings were voiced both by home owners and public agencies -- especially those responsible for mosquito abatement programs -- received citizen reactions.

Many suburban residents apparently endorse pesticides they use or cause to be used on their own premises, while opposing pesticide applications by public agencies beyond their immediate control.

RECOMMENDATIONS

Use Patterns

1. To obtain a more complete picture of the total national pesticide input into the environment, collect information on the distribution and use patterns of about 500 million lbs. of pesticide active ingredients which are produced annually, but not accounted for by farm use.

2. Extend the present study to other geographical areas so as to obtain an estimate of the total national home and garden pesticide consumption.

3. Extend study to all other non-farm pesticide uses which, together with home and garden uses make up the 500 million lbs. of pesticides about whose disposition we currently know so little.

LITERATURE REFERENCES

1 United States Production and Sales of Pesticides and Related Products, 1970, Preliminary, United States Tariff Commission, Washington, D. C., September, 1971.

2 Economic Research on Pesticides for Policy Decision-Making, Proceedings of a Symposium, Washington, D. C., U. S. Department of Agriculture, Economic Research Service, 1970.

APPENDIX B

TRANSPORT MECHANISMS

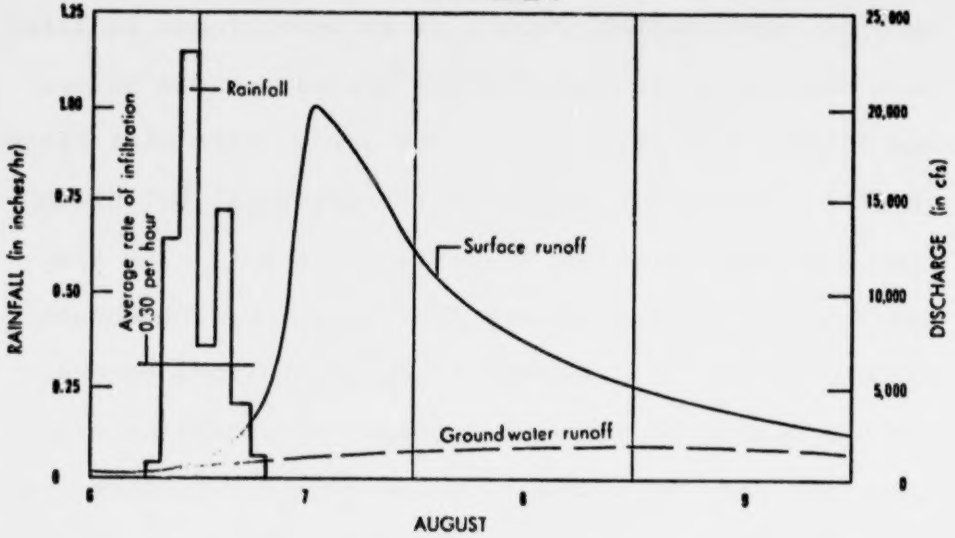
The process of pesticides entering the water environment from urban area run-off is not very well defined. There are a few measurements made which may hint at pesticide contamination from urban areas but little proof is shown. In the three study cities, Philadelphia has essentially no values (2 stations). Dallas has one station below the city, and Lansing has been the site of a special study on DDT. None of these studies attempted to show a transport mechanism or prove a relationship between measured levels in water and land sources. This appendix, which concerns itself with the problem of transport mechanisms, must therefore be limited to a statement of transport systems suspected of being sensitive to the parameters and a discussion of the impact of changing them.

Transport Mechanism From Point of Application Into Water

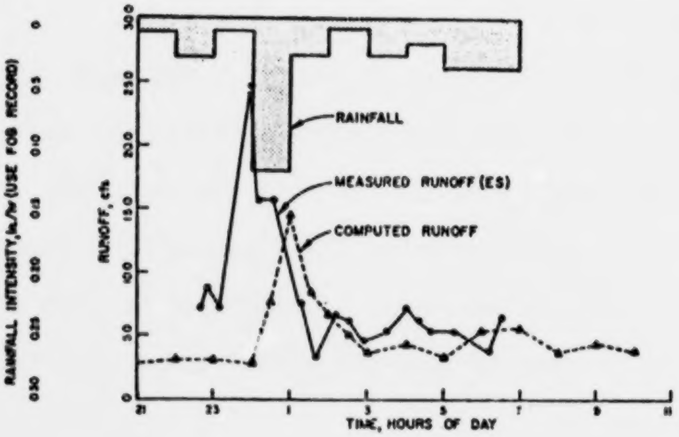
Most pesticide materials are insoluble in water, or are only slightly soluble. Some herbicides can be formulated as esters or salts which will dissolve in water. However, these materials are much less toxic to aquatic organisms than are the insoluble insecticides, hence the herbicides pose little problem as a water pollutant. The insoluble materials are mixed chemically to form water suspensions for application or they are applied as some type of solid (see Relationship of Techniques to Run-off, this appendix). These formulations lose their water mobility in time and become adsorbed on organic material present at the target site, but they can be carried away as a suspension if run-off occurs before they can be adsorbed. They can also be carried attached to solids which are physically transported in run-off during and following a heavy rain.

Home and garden pesticides enter the water environment carried in run-off from grass areas as emulsions or on sediments physically carried by moving water or both, depending on the amount of run-off. Studies made on urban run-off and its effect on water quality (1) (2) show that run-off peaks virtually as soon as rainfall does, that is, there is little or no delay caused by water soaking into the ground, at least in the city.

Figure 1-B (a) shows this peaking phenomena in the urban environment while Figure 1-B (b) shows a much different pattern for rainfall from a rural location. The non-urban area with a high percentage of vegetation tends



(A) The rainfall and runoff shown in this graph resulted in an August flood at Sugar Creek, Ohio.



(B) Baker St. combined wastewater overflow results - storm of April 4-5, 1969. (Cfs X 1.7 = cu m/min; lb X 0.454 = kg; in. X 2.54 = cm.)

FIGURE 1-B

to store the rainfall from a storm and release it later, so a measure of automatic flood control exists before man arrives and restructures the land. This difference is very significant as far as the potential pollution from suburban pesticide usage is concerned. The slow, delayed peak implies slower flowing water, the chance for deposition of sediments to occur and less general overall chance for erosion. The urban situation with its rapid peak does none of these things. Erosion, sediment transport, with concurrent pesticide transport, if pesticides have been used, can be expected from even a fairly minor storm. Programs to reduce these run-off peaks would not only prevent flood damage but help keep pesticides from being transported as well.

Suspended solids which include dust and dirt from gutters, leaves, debris from lawn clippings and the like, peak at the same time, indicating the greatest potential for pesticide contamination from pesticides adsorbed on sediment materials occurs during the peak of a storm, or when the peak slug of run-off water first enters the receiving water.

There have been few studies made of pesticides during storm run-off and the studies completed show a lack of structuring to detect this peak flow phenomena. A study at Columbus, Ohio found dieldrin only 4 times in storm sewers in several rainfall events in 1969. This program took samples after the rainfall peak and thus missed the potential to document the amount of pesticide transport (4).

Weibel, et al. (2) studied the pollution implications of urban run-off and although they did not quantify pesticides per se, they included a measurement of organic chlorine in the urban run-off study around Cincinnati. The average amount of organic chlorine was 1.7 ug/l in the 22-month study period. Since many, but not all, pesticides are structured with chlorine attached to carbon, they can be, but were not proven to be, a source of the chlorine in the run-off. Many industrial sources could also have contributed these materials. Weibel did measure and demonstrate drift of pesticides when he showed DDT in rainfall run-off from an orchard area which had never been treated with this material. However, a vineyard 500 feet away had received DDT. These authors also demonstrated transport of pesticide on dust and its subsequent deposition in rainfall.

Weibel found the following pesticides in one rainfall at Cincinnati, Ohio. This was a very low volume rain which washed enough dust particles out of the sky to produce a mud like covering on surfaces it contacted.

TABLE 1-B

Pesticides	Concentration ppm*
Chlordane	0.5
Heptachlor epoxide	0.04
DDE	0.2
DDT	0.6
Ronnel	0.2
Dieldrin	0.003
2,4,5-T	0.04

*Based on air dried weight of dust.

The dust-laden rain would clearly contaminate water it fell onto and might be a supply of pesticide in an urban area as well as a removal transport mechanism in run-off.

In the three study cities, little monitoring data exists to show the extent of pesticide contamination. Tables 2-B, 3-B show these results for Philadelphia and Dallas from the STORET System. No data is available for Lansing, Michigan from this source (5). In Philadelphia, DDT, DDD, and dieldrin were detected in the Schuylkill River at some time in a 10 year sampling interval. These samples were a once a year grab sample and, as such, are worthless in determining the pesticide deposits in the river from the suburban area. No samples were taken to see where the pesticides were coming from.

The State of Texas, Department of Agriculture (6) began a series of pesticide measurements on sediments in selected river basins in the state in 1970. These data

TABLE 2-B

PESTICIDES AT THE TWO PHILADELPHIA SAMPLE STATIONS 1959-1969 (in parts per trillion (ppt))

Compounds	Philadelphia 1 Schuylkill River	Philadelphia 2 Delaware River
aldrin	0	66*
BHC	0	800*
Chlordane	0	--
DDD	9*	13
DDE	0	1.5
DDT	0.7	10
dieldrin	17.3	8.7
endrin	0	0*
heptachlor	0	13*
heptachlor epox.	0	0.9

Values are means for ten or more samples in the sample period.

*Samples are a value for one single positive value, all others in the period being zero.

TABLE 3-B

PESTICIDES IN TRINITY RIVER BELOW DALLAS TEXAS 1970-1971 (in parts per trillion (ppt))

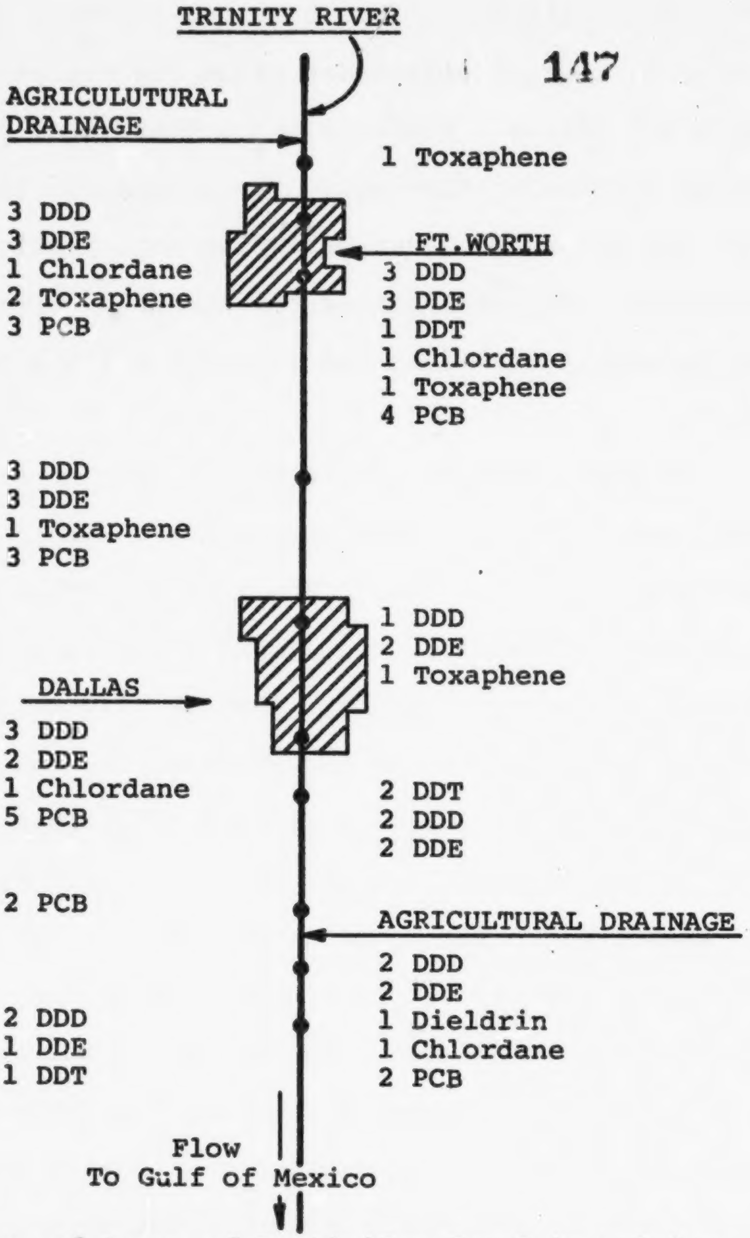
Compound	Water	Mud
Aldrin	0	-
BHC	0	0*
Chlrodane	560	-
DDD	25	1300*
DDE	0	0*
DDT	120	0*
dieldrin	80	1300*
endrin	0	0*
Toxaphene	0*	-
heptachlor epox.	0	0*
heptachlor	0	0*
malathion	590	-
parathion	0	-
diazion	550*	-
m-parathion	0	-
2,4-D	445	0*
2,4,5-T	50	0*
Silvex	0	0*

*Single value reported. Other values are means of 2 samples in sampling period.

for the Trinity River show a marked increase in the number of variety of pesticides below the cities of Fort Worth and Dallas. There is not a consistent pattern either in time or flow along the stream but it is clear that the urban area must be adding some pesticides to the river. Figure 2-Bshows the number of times different materials were reported although not the range or source.

Sediment analyses below Dallas show an extremely high amount of PCB's, August 11, 1971. This raised the question of whether this PCB source was urban run-off or industrial waste since the sample point is slightly below the Dallas sewer plant. A check of weather bureau records shows no rain on August 10 or 11, and only 0.18 inches on the 9th, which fell in a three hour period. This is unlikely to have produced a run-off sufficient to cause a concentration of 1000 ppb PCB. No insecticides were reported at this time, leading to the conclusion that the PCB's were from an industrial source.

This incident demonstrates the fact that a sampling system is needed which will sample during and after a rainfall/run-off incident, not on a calendar basis. To further illustrate, on August 13, 2 days after the sample was taken a 2.21 inch rainfall event occurred. This run-off and heavy rainfall would produce


TRINITY RIVER
AGRICULUTURAL DRAINAGE
1 Toxaphene
3 DDD
3 DDE
1 Chlordane
2 Toxaphene
3 PCB
FT.WORTH
3 DDD
3 DDE
1 DDT
1 Chlordane
1 Toxaphene
4 PCB
3 DDD
3 DDE
1 Toxaphene
3 PCB
1 DDD
2 DDE
1 Toxaphene
DALLAS
3 DDD
2 DDE
1 Chlordane
5 PCB
2 DDT
2 DDD
2 DDE
2 PCB
AGRICULTURAL DRAINAGE
2 DDD
2 DDE
1 Dieldrin
1 Chlordane
2 PCB
2 DDD
1 DDE
1 DDT
Flow
To Gulf of Mexico

Number and types of Pesticides found in Trinity River Sediment 1970-1971

Figure 2-B

pesticide transport of any residues present on the surface, but no analysis was made which would show this.

Gaps in data like this contribute to an overall lack in the picture of what is really happening in pesticide transport.

The contractor contacted wastewater treatment plants and water works in the three study cities to attempt to collect data which would show the amount of pesticides entering the water from sewage plant effluents or found in the waters used for water supply. The results of these contacts were futile. No one routinely makes measurements of even total pesticides in an effluent. In Philadelphia, the situation is compounded by the geography of the area. There are several small watersheds on both sides of the Schuylkill River which drain the suburban area and discharge in turn into the Delaware River, which is a tidal estuary at Philadelphia. At the mouth of nearly every one of these creeks is a sewage treatment plant of fairly small size. Many of these plants were built in the 1930's as CCC projects and some have not been enlarged since then. The areas they serve often have separate storm and sanitary sewers to help prevent overload by stormwater. When rain and run-off occur these plants process as much wastewater as they physically can and dump, without measuring the volume, the rest directly into the waterways. The run-off is thus in three segments: (1) the portion treated with normal sewage up to capacity of the plant, (2) the portion bypassed untreated at the plant, and (3) the portion which is collected in the storm sewer system and discharged to the many creeks in the area without any attempt at treatment. Throughout this series of events no pesticides are measured. The staffs of the treatment plants contacted were helpful in supplying operating data about their facilities but it is not included here since no conclusions can be drawn from it.

Dallas and Lansing exhibit a somewhat different drainage pattern in that each of them has a single flowing river receiving wastewater from the city. In Dallas, the Trinity River serves this function. In Lansing, the Red Cedar is the receiving stream. If an adequate program of monitoring above and below these cities was established it should be possible to estimate by difference, calculations of the amount of pesticides contributed by the cities. To date, this has not been done regularly.

There was one study of the Red Cedar made in which a number of stations were examined. Zabik (7) looked at the Red Cedar above, in and below Lansing over a period of two years. His study concentrated on DDT in water, suspended matter and bottom deposits. Although he was able to calculate an increase of almost 100 percent in the DDT of the river below the two sewage treatment plants in the area, his study was not sensitive to the previously mentioned run-off parameters, therefore, his samples do not represent a continuous on-going picture of the problem. Zabik does make the interesting observation, which agrees with agricultural pesticide studies, that water concentrations of pesticides are a poor indicator of contamination due to extremely low solubility, that pesticide residues on suspended solids are a much more accurate indicator of recent pollution, and that bottom sediment concentrations show the past history of pesticide involvement in a river basin. The implication is that any monitoring system needs to include sediments and suspended matter as a routine portion of the analysis, perhaps as the analysis, except in cases of acute poisoning where the source needs to be determined.

In one of the few instances where pesticides were measured in actual run-off under field conditions, Edwards and Glass measured methoxychlor being removed from pastureland grasses in Ohio. This pasture grass was not a suburban lawn; but rather a mixture of coarse field grasses that was not mowed to the short length of a lawn. These measurements are never the less important because they represent pesticides in run-off from a stable, non-plowed field. Soil erosion does not occur under such conditions and the resulting loss of pesticides adsorbed on soils does not occur.

Glass and Edwards (8) applied methoxychlor in March at a very heavy dose of 22.4 kg/ha or 19.6 pounds/acre. This rate far exceeds normal agricultural application rates and, according to contractor estimates, is about twice the maximum rate applied by home and garden users. Run-off was sampled after all rainfalls for 14 months following application; the total methoxychlor removed in run-off was found to be 0.004 percent, a seemingly insignificant amount of the applied dose. No pesticide was found in the ground water below the test plot throughout the study. The implication of this study is that, once applied to the stable situation of grass cover, the pesticide will remain and not cause water contamination. No run-off occurred for six days after the methoxychlor was sprayed onto the field, allowing some time for the spray emulsion to break before rainfall occurred. The first run-off had only 0.1 ug/l of methoxychlor in it.

Soil and Soil Types

Soils and soil types can be significant in the relationship of pesticides to the water environment in several ways. Since pesticides can adsorb strongly to soils, the soil may become a depository for substantial amounts of pesticide as repeated applications are made over the years. The compaction of the top soil layer will affect the propensity of rainfall to soak into the land or run-off into a water system. The organic and clay content of soil is important to the pesticide carrying capacity of soils since pesticides adhere most strongly to organic matter and to clays, with their electrically charged surfaces. Inert soil components such as sand have much less affinity for pesticides. The pH of the soil may influence the rate of chemical breakdown of pesticides which are on soils (9).

Pesticides Associated with Sediment Transport

Erosion of soils in urban areas depends on slope of the land, frequency of heavy rainfall and rate and extent of new construction. The process of clearing land and building on it usually exposes large amounts of soil to rainfall. These uncovered areas lose the protective, energy absorbing properties of the previous vegetation so that erosion occurs during and after construction until a new growth is established or the area paved. This series of events is significant in terms of the amount of soil eroded as the cities grow and new suburban areas are created. The contractor is aware of one reservoir in the suburban Philadelphia area which has filled in 1/4 to 1/2 mile of its length and has had the width reduced from 700 to perhaps 25 feet over the past 15 years as the land upstream from the reservoir was changed from wooded hills and pastureland to subdivisions for Philadelphia area residents.

If the land was used for agricultural purposes or for orchards before the construction phase began, it was potentially exposed to pesticide residues and drifts connected with the prior use. Erosion of soil, especially the rich topsoil which is usually scraped into a pile at the edge of construction, can be expected to carry large quantities of pesticides and persistent residues, such as DDT and its metabolites, to the waterways.

This process probably occurs more rapidly in Philadelphia with its steep hills and many small streams than in either Dallas or Lansing, which are comparatively flat and level cities on plains regions, while most of the Philadelphia area is on hard rock of the Piedmont uprising.

The organic content of soil and the moisture or moisture holding capacity of the soil greatly affect the pesticide holding capacity of the soil (9). Pesticides are complex organic molecules which have a tendency to adhere to other organic material, such as humus in soil. The amount of moisture present can markedly affect this attraction as Spencer (10) has shown. When the soil is dry, more pesticides can be held on the soil, and as the moisture increases water will displace some of the pesticide residues, allowing greater evaporation to occur.

The higher the organic content of the soil the more pesticides will be held on the soil and less will be released to the water environment during times of heavy run-off.

Relationship of Techniques to Run-off

The study of transport of pesticides from suburban home and garden use to the water environment requires a brief look at the application techniques used by the suburbanite to get the products onto the target. Herbicides for control of lawn weeds and some insecticides for insects in the lawn can be purchased in granular form, or mixed with solid fertilizer. These combination pesticide-fertilizer granules are applied by a spreader calibrated to apply a given rate of fertilizer on a pound/square foot basis. The pesticide is physically held to the fertilizer and goes on at the correct rate. Solid pesticide materials may be spread without fertilizer with a spreader as well. These compounds have a low percentage of active ingredient and a high percentage of inert carrier to make distribution easier. Since fertilizer can serve as a distributor agent and allow application of two materials at one time, the mixtures are becoming popular combination products.

The second major application technique is the hose end sprayer. A liquid pesticide, or a suspension of a solid and a wetting agent fill a small reservoir, and water flowing through the hose aspirates a given amount of pesticide, per unit volume of water from the bottle. The pesticide and water mix are sprayed onto the ground or onto trees, shrubs, and bushes to be protected.

Dusts, sprays, and liquids in small quantities can be applied to particular plants, such as roses, needing special protection or to specific pests such as dandelions in a lawn. These "spot treatments" apply pesticides at a fairly high concentration but to a small area and in low total quantity so they don't pose a great threat to the environment.

How do the formulations affect the tendency of these materials to enter waterways? Consider the hose end sprayer putting out a liquid pesticide formulation.

The bulk of the material applied is water. The pesticide itself is insoluble or only slightly soluble in water so it is mixed with an emulsifier which can form a suspension of organic material in water. Water soluble detergent-like materials called surfactants are used with organic solvents to perform this function. Once the pesticide is on the ground, this emulsifier should dissipate so that subsequent rain will not pick up the pesticide and carry it away. The length of time the emulsifier stays effective in unknown, but a time of at least 2-3 days is not unreasonable to assume. If rainfall is heavy enough to cause run-off, some of the pesticide will probably be carried away.

Opposing this action is the fact that the pesticide is being applied to an area which has organic material - live grass, dead grass shreds, decaying leaves and other organics which tend to build up the humus of the soil. Pesticides, being organic chemicals, have a much greater affinity for organics than for polar inorganic materials such as water. Thus the pesticide tends to "stick" to the organic matter on the ground and resist movement by water run-off.

Solid materials on the other hand fall into this rich organic maze and may be physically trapped among the particles. These then are the apparent fates of the pesticides when they are applied to the suburban home and garden environment.

After contact with retailers, manufacturers, and professional agricultural personnel, as well as information obtained from homeowner surveys, the contractor believes that the pesticides are applied in a very short time period - primarily the 4 weekends in May, with some application the last weekend in April and the first in June. Manufacturers felt that bad weather during any of these time periods cut irreparably into their sales for the year. If rain occurs in the period Sunday afternoon to Wednesday morning of these 6 weeks, there should be a greater chance of having the liquid spray applied pesticides free and mobile to be carried off to the water.

Tables 4-B, 5-B and 6-B show the distribution and amount of rain in the three study cities for 1968 through 1971 in this heavy application period. Rainfall on Saturday probably means no pesticide application that weekend while rain later in the week may tend to wash away the applied material. The column entitled "Rainy Weekend Pattern" attempts to summarize the occurrence of rain which could be significant in application terms. The distribution of rainfall throughout the day was taken into account in determining this pattern, thus it

TABLE 4-B

RAIN IN APRIL, MAY, AND JUNE FOR DALLAS

	1968					1969					1970					1971					Rainy Weekend Pattern	No. of Rainy Weekends
	S	S	M	T	W	S	S	M	T	W	S	S	M	T	W	S	S	M	T	W		
April Last						26)	27)	28)	29)	30)	25) 2.05	26) T	27) 0	28) 0	29) T	24) 0	25) 0	26) 0	27) 0	28 T	- Y - N	1
May 1	4) 0	5) 0	6) 0	7) .31	8) 0	3) 0	4) .46	5) 1.59	6) 4.49	7) .93	2) 0	3) 0	4) 0	5) 0	6) 0	1) 0	2) 0	3) 0	4) 0	5) .03	N N N N	0
2	11) .47	12) .06	13) 1.67	14) 0	15) T	10) 0	11) 0	12) 0	13) 0	14) .25	9) 0	10) 0	11) 0	12) 0	13) 0	8) .01	9) .01	10) .06	11) 0	12) 0	N N N M	1/2
3	18) 0	19) 0	20) 0	21) T	22) 0	17) .66	18) .24	19) 0	20) 0	21)	16) 0	17) 0	18) 0	19) 0	20) 0	15) 0	16) 0	17) 0	18) .02	19) T	N N Y N	1
4	25) .10	26) 0	27) 0	28) 0	29) 0	24) 0	25) .01	26) .07	27) 0	28) .09	23) 0	24) 0	25) 0	26) .12	27) .39	22) 0	23) 0	24) 0	25) 0	26) 0	N N N N	1
5	-)	-)	-)	-)	-)	31) 0	1) .02	2) 0	3) .28	4) 0	30) 2.15	31) T	1) T	2) T	3) 0	29) 1.0	30) T	31) T	1) T	2) 0	- M N Y	1 1/2
June 1	1) 1.0	2) T	3) .01	4) .21	5) T	7) 0	8) 0	9) 0	10) 0	11) 0	6) 0	7) 0	8) 0	9) 0	10) 0	5) 0	6) 0	7) 0	8) 0	9) 0	M N N N	1/2

Rainy Weekend Key:

N	not rainy - lawn & garden activities likely
M	intermittent rain, daytime - questionable activities
Y	Yes, pronounced rain during day - unlikely outside activities
-	No 5th weekend that month

TABLE 5-B

RAIN IN APRIL, MAY AND JUNE FOR PHILADELPHIA

	1968					1969					1970					1971					Rainy Weekend Pattern	No. of Rainy Weekends
	S	S	M	T	W	S	S	M	T	W	S	S	M	T	W	S	S	M	T	W		
April Last						26)	27)	28)	29)	30)	25) 0	26) T	27) 0	28) 0	29) 0	24) T	25) .01	26) T	27) 0	28) .25	N N	0
May 1	4) T	5) .40	6) .02	7) 0	8) 0	3) 0	4) 0	5) 0	6) 0	7) 0	2) 0	3) T	4) .03	5) T	6) T	1) 0	2) .06	3) .02	4) 0	5) T	N M N M	1
2	11) .62	12) .49	13) T	14) 0	15) .06	10) T	11) T	12) T	13) T	14) T	9) 0	10) 0	11) T	12) T	13) T	8) .76	9) .01	10) T	11) O	12) T	Y N N Y	2
3	18) T	19) .12	20) 0	21) T	22) 0	17) 0	18) 0	19) .43	20) 1.64	21) 0	16) T	17) .60	18) T	19) .21	20) 0	15) .01	16) 1.72	17) T	18) O	19) O	N Y N Y	2
4	25) 0	26) 0	27) .10	28) 1.55	29) .54	24) .06	25) T	26) 0	27) 0	28) 0	23) .51	24) .02	25) T	26) 1.02	27) 0	22) T	23) 0	24) 0	25) .14	26) 0	N M N N	1/2
5	-)	-)	-)	-)	-)	31) 0	1) 0	2) 0	3) .81	4) 0	30) 0	31) 0	1) 0	2) 0	3) .02	29) T	30) .25	31) .01	1) 0	2) .05	- N N Y	1
June 1	1) 0	2) .03	3) .08	4) 0	5) 0	7) T	8) .06	9) .08	10) 0	11) 0	6) .19	7) 0	8) 0	9) 0	10) .12	5) 0	6) .01	7) .01	8) T	9) 0	N Y N N	1

TABLE 6-B

RAIN IN APRIL, MAY, AND JUNE FOR LANSING

	1968					1969					1970					1971					Rainy Weekend Pattern		No. of Rainy Weekends
	S	S	M	T	W	S	S	M	T	W	S	S	M	T	W	S	S	M	T	W			
April Last						26)	27)	28)	29)	30)	25) 0	26) 0	27) 0	28) .04	29) .07	24) T	25) 0	26) 0	27) .07	28) .05		N N	0
May 1	4) .03	5) T	6) 0	7) 0	8) .04	3) T	4) 0	5) T	6) .07	7) .01	2) 0	3) T	4) .02	5) T	6) 0	1) .11	2) T	3) 0	4) 0	5) T	Y N	N N	1
2	11) 0	12) .02	13) T	14) .45	15) .11	10) T	11) T	12) 0	13) 0	14) 0	9) 0	10) 0	11) 0	12) .53	13) .53	8) 0	9) 0	10) 0	11) .26	12) .16	N N	N N	0
3	18) 0	19) 0	20) .15	21) 0	22) 0	17) .48	18) .62	19) T	20) T	21) .04	16) .02	17) 0	18) 0	19) 0	20) 0	15) 0	16) T	17) 0	18) 0	19) .07	N Y	N N	1
4	25) 0	26) 1.75	27) .99	28) .02	29) T	24) 0	25) .07	26) 0	27) 0	28) 0	23) .06	24) .61	25) .18	26) .21	27) .08	22) 0	23) 0	24) 1.28	25) .03	26) .01	Y N	M N	1 1/2
5	-)	-)	-)	-)	-)	31) .45	1) .60	2) .22	3) T	4) .24	30) T	31) 0	1) .18	2) .21	3) .08	29) 0	30) 0	31) T	1) T	2) .06	- Y	N	1
June 1	1) .04	2) 0	3) 0	4) 0	5) 0	7) 0	8) 0	9) 0	10) 0	11) 0	6) 0	7) 0	8) 0	9) 0	10) 0	5) .05	6) .60	7) T	8) T	9) 0	M N	N M	1

is possible to show both a rainfall and a not rainy pattern the same calendar day, if the rainfall was during the hours of darkness.

All three study cities have approximately the same number of rainy weekends throughout the data period - geographical location does not appear to alter this phenomena (11). The significance of this procedure is unknown, since no data exists to show pesticides in run-off during this time, however, it does suggest an interesting field study to see how big a pollution problem exists from these applications. The study included the week days through Wednesday because the contractor felt this would probably provide enough time for water emulsion to break and for the emulsifiers to decompose or adhere to other materials enough to prevent motion if later rainfall occurred. The literature failed to provide data on the effective life of these emulsion materials. Table 7Band Figure 3Bshow the possible conditions of rainfall during and following application weekends as the resulting potential for contamination of water by liquid applied pesticides. Figure 1 clearly indicates that only Condition IV (a dry weekend followed by a wet week) has a potential for contamination of run-off waters.

Since this set of circumstances cannot be controlled

TABLE 7-B

POTENTIAL FOR WATER CONTAMINATION BY LIQUID HOME AND GARDEN PESTICIDE APPLICATION

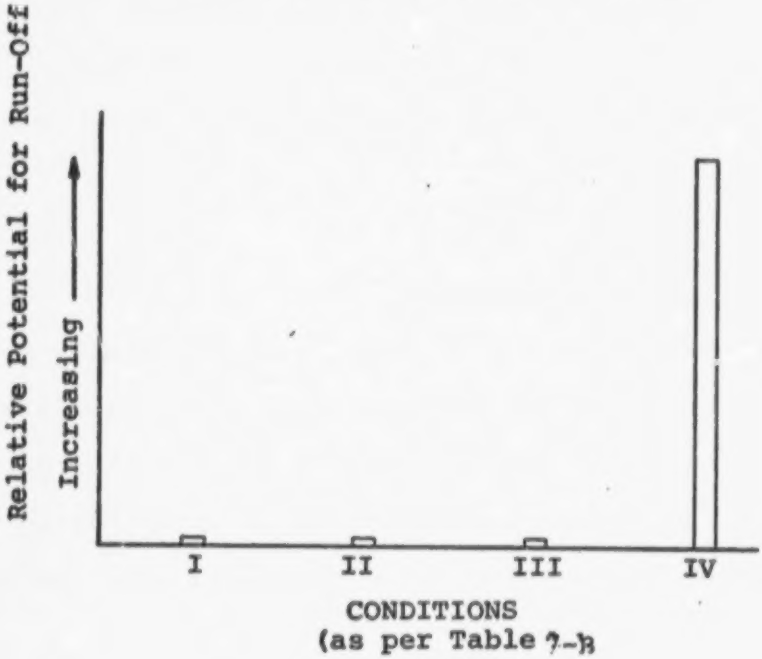
Weekend Weather/ → Week's Weather ↓	Rainy	Dry
Dry	I Low (1)	II Low (2)
Rainy	III Low (1)	IV Very High

(1) No application - bad weather keeps homeowner inside.

(2) Application will occur. No run-off to cause problems.

FIGURE 3-B

POTENTIAL FOR WATER POLLUTION



and cannot be accurately predicted several days in advance and since pesticides have created a continuing demand for their use, clearly the most effective way to minimize this potential is to change the formulation so that run-off from rainfall does not pick up pesticides.

Research into very short lived emulsifiers, those with a 10-15 minute working life after application, should receive a major support if this potential for pollution is to be removed. Application of most pesticides as granules instead of liquids could also help lower this peak.

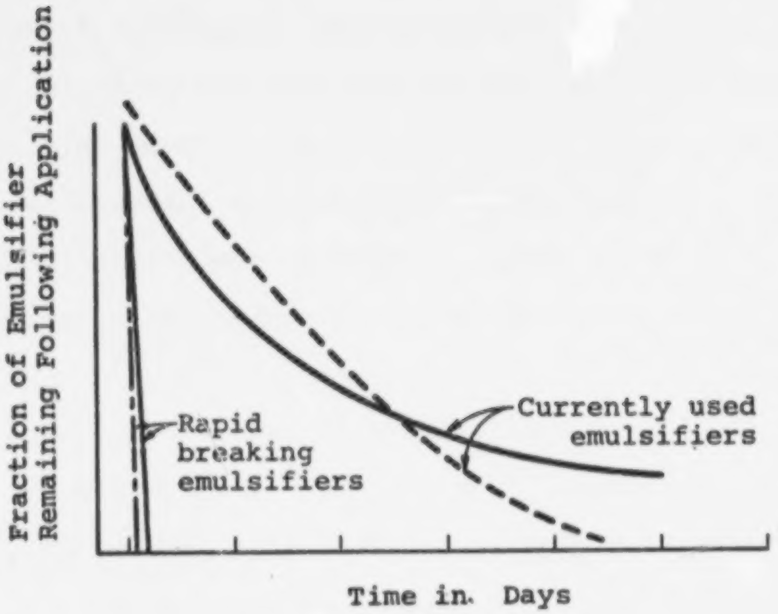
Figure 4Bdiagramatically shows the evaporation rates of present emulsifiers and the potential for liquid pesticides to be carried off by run-off until the emulsifiers dissipate. If the emulsifier is dissipated in several minutes, as proposed above, this potential drops to a lower value very quickly and ceases to be a problem.

Ranking of Transport Mechanisms

Liquid based pesticides have a high propensity to enter run-off as long as they are in an emulsified state. The time of mobility is determined by the emulsion used to disperse the pesticide in the carrier water but is believed to be on the order of 3 to 5 days. The emulsi-

FIGURE 4-B

POTENTIAL FOR LIQUID PESTICIDE TO CONTAMINATE RAINFALL RUN-OFF



Solid Line - Fraction of emulsifiers remaining following pesticide application with different types of emulsifiers shown.

Dotted Line - Potential for liquid pesticide to contaminate water with different types of emulsifiers shown.

fiers evaporate after application, leaving the pesticide behind on the target. The pesticide is adsorbed on the surface of organic material present in the target area and thus becomes anchored at the target area. However, if rainfall occurs after application but before the breaking of the emulsion by evaporation or adsorption, or both, the rain-produced water may combine with the pesticide emulsion and carry it off. The contractor feels this is the greatest potential transport mechanism for materials applied to the target area. A complete summary and ranking of pertinent pesticide transport mechanisms is shown in Table 8-B.

In Dallas, spray applications of insecticides to entire lawns is commonly done to control root worms and grubs. These ground insects are less of a problem in Lansing and Philadelphia, so less area spraying of lawns is done.

Application of pesticides as solids is also a common way of applying a blanket layer of pesticide to a lawn. With this method, the granular or powdered formulation is spread over the lawn where the granules tend to lodge in the grass or other cover material and be mechanically trapped. Gentle rain helps settle them into the lawn where they are immobile. Thus, these materials pose a smaller potential pollution problem than the liquids.

TABLE 8-B

PESTICIDE TRANSPORT ROUTES

Rank*	Route to the Environment	Relative Significance
1	Overland Drainage	
	Emulsions in Water	Greatest
	Sediment Street Debris	Moderate to High
	Construction	Moderate
	Granular Formulation	Low
2	Intentional Dumping of Leftover Materials	Great (potentially)
3	Accidental Spills	Great (potentially)
4	Container Disposal	Great (potentially)
5	Atmospheric Processes	
	Evaporation from Land	Moderate
	Evaporation during Application	Low
	Drift	
	individual	Low
	commercial	Moderate
6	Movement in Ground Water	Low

*In descending order of importance

Empty Container Disposal

Empty containers are thrown into the household trash in all three study cities. This refuse is either buried in landfill operations or burned in municipal incinerators. In either case the potential is great for water contamination. In a landfill, water can often percolate down through the refuse and contaminate ground water. This has happened and is a consideration to be taken into account when building a landfill. There are no reported cases of pesticides being in the leachate or causing contamination, however, chemical measurements on leachate are seldom made and the overall effect leachates have on water quality is poorly understood (12). In an incinerator the residue from the burning operation is quenched with water and the combustion gases may be. This water quickly becomes contaminated and may pose a severe pollution problem unless it is carefully processed. Often this water is fed to a municipal sewer system where some pollutants may be reduced. However, sewage treatment systems do not remove pesticides so any pesticide residues from the incineration will travel to the receiving water almost unchanged. Thus the contamination from empty containers is not known or quantifiable.

The problem of leftover chemicals or bottles which are rinsed out is also unanswered. These materials may be poured down a drain to get rid of them. If this happens, they end up in the receiving stream as outlined above.

In a study on landfill operations, Fungarlio (12) inventoried in the field the materials going into a landfill in the suburban Philadelphia area. Part of this survey was run in May when pesticides were being applied and when the containers should have been thrown away. His survey failed to find pesticide containers in the mixed domestic refuse. One conclusion which might be drawn from this is that the containers are such a small percentage of the total volume in a landfill that they are not significant. Since the possibility of ground water contamination and accidental poisoning to the operators exists this area should receive further study.

It is obvious from the foregoing discussion that the contribution suburban homes and gardens make to the pesticide levels in our waterways is unknown and could be the subject of an intensive research study. The use of granular materials which are not mobile will help decrease the contamination.

Table 9B summarizes data from Appendix A on the use of pesticides in the suburban home and garden environment and shows the contractor's best estimate of the relative use of pesticides by each of the three major major user categories. The homeowner applies 619,400 pounds or approximately 83 percent of the total in the study cities. From available land use data and estimates on the number of square feet of lawn and garden in suburbia, the contractor feels the application of this amount of pesticide leads to an average of a total of 7.2 pounds per acre as shown in Table 10-B.

TABLE 9-B

DALLAS, PHILADELPHIA, AND LANSING
TOTAL PESTICIDE USE

	Pesticide (in pounds)*		
User Group	Herbicide	Insecticide	Fungicide
Individual Homeowner	121,600	429,000	68,800
Commercial Sprayer	Negligible	51,090	6,700
Public Facilities**	6,200	22,700	44,000
TOTAL	127,800	502,790	119,500

*Values expressed in pounds of active ingredients.
**Golf courses, parks, mosquito abatement.

The homeowner has a very poor idea of what materials he is applying as shown in Appendix A and the Summary Statement of this report. To minimize environmental contamination by pesticides in the home and garden environment, legislation, education, and persuasion are all needed to help the homeowner reduce the environmental impact of his pesticide use. Laws prohibiting the unrestricted sale and use of persistent, damaging products would help. Substitution of effective but less persistent materials coupled with a strong educational program through the mass media, naming common names and dose rates would be a step in the right direction. Granular formulations and sticky dusts for vertical or exposed surfaces could be provided as alternatives to liquids and sprays. The biggest problems are in implementing their use, but this is not an insurmountable problem if approached with the correct selling program.

Table 10B also shows a comparison of home and garden use rates with agricultural use rates in the midwest. The home and garden use is 1 to 5 times as high as the agricultural use on a per acre basis. Consideration of the number of acres under cultivation shows, however, that the agricultural use is far greater than the home and garden use, and further consideration of transport mechanisms shows that much more of the agriculturally applied material can be expected to be transported due to erosion than in the home and garden situation.

TABLE 10-B

ESTIMATED INDIVIDUAL HOMEOWNER PESTICIDE USAGE RATE

	Pesticide Dosage Rate*		
	Herbicide**	Insecticide**	Fungicide**
Homeowner	1.4	5.0	0.8
(Agricultural	0.5 to 2.5	1.5 to 3.0	Negligible)

*Based on estimated 3000 square feet of lawn and garden receiving pesticide treatment per resident.

**Pounds of active ingredients per dwelling unit.

Pesticides used in the home and garden market are applied to small areas by hand operated devices by the homeowners, mostly in 4 to 6 weekends in the spring of the year. The active material is diluted either in water or in a solid mixture for a uniform, low dose application to the target. If rainfall occurs soon after application, run-off may contain pesticides, although attempts to document this have failed to show significant quantities of pesticides to date.

The fate of leftover materials is unknown - but some homeowners contacted admitted pouring them down a drain. However, sewage treatment plants do not measure for pesticides due to the high cost of analyses and the fact that treatment systems do not remove pesticides, so the plant could do nothing even if it knew the materials were present.

Empty containers in the suburban area are thrown into refuse from the house for municipal or private collection. They subsequently are buried in a landfill or dumped or burned in an incinerator. If properly maintained, the incinerator could destroy the materials but air pollution and mechanical problems with existing incinerators make this an uncontrollable solution.

Recommendations

1. Verify application pattern suggested in this Appendix.
2. Set up monitoring to record daily levels at sewage plants and peaks from storm run-off to generate enough data to allow an accurate inventory of pesticides entering water from suburban use.
3. Set up educational program through mass media to show best ways of disposing of left over materials and empty containers. Approaches such as deposits on returnable cans might help keep the containers away from the water environment.
4. Develop emulsions which will persist only a few minutes after application, thus reducing the chances of subsequent rain carrying pesticides away from the target.

5. Institute, by legislation, different programs of land clearing during construction. Allow only that area actually required to be disturbed for construction to be denuded. Reduce practices such as mass removal of trees and bushes which break the force of rainfall and help check erosion.

6. Institute a series of storm run-off control devices which will keep run-off at a low level longer, and catch sediment in the process, keeping the sediment on the land rather than allowing it to enter the waterways. If a large area must be disturbed in construction, encourage the planting of rapid growing materials, such as black mustard weed, which would provide temporary ground cover to reduce erosion.

7. Formulate all possible pesticides as granules rather than liquids for sod applications.

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APPENDIX C

DEGRADATION OF HOME AND GARDEN PESTICIDES

The survey results detailed in Appendix B of this report indicate that a large number of different pesticide active ingredients are contained in home and garden pesticide products. These active ingredients represent a variety of different chemical groups. Many of these chemicals are also used for agricultural and other pest control purposes. Many of them have been in commercial production and use for many years, including the phenoxy-type herbicides, atrazine, chlordane, dieldrin, methoxychlor, carbaryl, malathion, diaxinon, PCNB, captan and others.

In recent years, many expert committees, panels, conferences and symposia have dealt with practically all aspects of pesticides, including their fate in the environment after application. Publications emanating from these activities include a report by the American Chemical Society entitled "Cleaning Our Environment - The Chemical Basis for Action;" (1) proceedings of an international symposium on "Pesticides in the Soil; Ecology, Degradation and Movement" (2) which was held at Michigan State University, East Lansing, in February of 1970, and the "Report of the Secretary's Commission on Pesticides and Their Relationship to Environmental Health," U. S. Department of Health, Education and Welfare, more popularly known as the "Mrak Report," (3) after its chairman.

Perusal of these and many other comprehensive studies and reviews of the state of the art by our best experts leads to the disturbing conclusion that, in effect, very little is known about what happens to pesticides in the environment after application under actual field conditions. Many investigators have studied individual factors or subsystems under laboratory conditions, but it is not clear, and the authors themselves usually are silent on the question, whether the results reported are applicable or even relevant to field conditions. It is surprising as well as deplorable that so few scientists in this area have ventured into studying what really happens in the field. As a result, very little is known about the pathways of metabolism and degradation and about the nature of the ultimate breakdown products of pesticides under field conditions. Not knowing the nature of these degradation products, we, of course, know nothing about where they might ultimately be deposited.

Information on the degradative mechanisms and on the chemical nature of metabolites and breakdown products is, of course, also important to the development of analytical methods suitable for monitoring work. Methods which are sensitive only to the parent compound are of limited value in efforts to determine the total environmental impact of chemicals.

While this type of information is lacking even for pesticides which have been in large scale commercial use for many years, including those mentioned above, it is likewise unavailable for pesticides which have been developed more recently and have thus far been registered and used primarily on non-food crops. Products in this category include the herbicides Bandane and bensulide; the insecticide Aspon, and the fungicide benomyl.

The contractor feels that it would be remiss if some indication of possible degradation routes were not included in this report. Thus, the contractor has concentrated some effort into an examination of the more pertinent routes of attack taken by many research workers in this field. Our method is to stress the compounds most commonly used in homes and gardens as determined by field studies. The approach is essentially a compound by compound presentation with whatever types of information are currently being researched. As stated above, laboratory results cannot readily be applied to field conditions, but it is felt that the identification of major pathways, where known, are helpful to guide future research efforts.

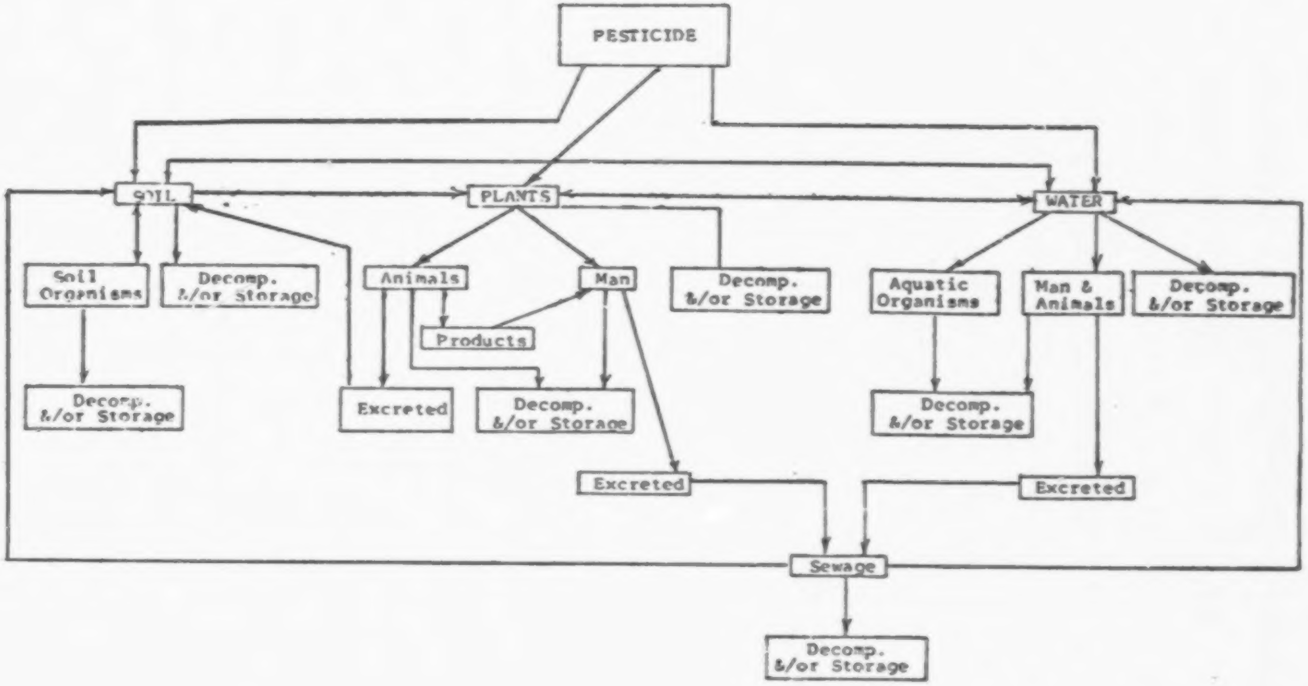
The Problem of Degradation

Degradation, used in its broadest sense, includes any measurable chemical change in pesticide molecules under natural environmental conditions. Such degradation may be complete or partial, depending upon the nature of the end products. (4). We have elected to include metabolic degradation as well, since many times the same essential process may be involved, whether it be the vertebrate liver system of an animal or soil microorganisms.

So many different factors affect the degradation of pesticides that it is almost impossible to identify them all. All attack on a molecule is chemical, whether mediated by biological means or not. Examination of Figure 1 (5) shows plainly the complex interaction possible between the biotic and abiotic factors of the environment and pesticide contamination. It would be desirable to know rates for each cell depicted under any given loading of a specific pesticide in addition to the physical features of the particular pesticide in aqueous solution and all possible degradation products

FIGURE 1-C

OUTLINE OF POSSIBLE RELATIONSHIPS BETWEEN PESTICIDES
AND ENVIRONMENT (5)


PESTICIDE
SOIL
PLANTS
WATER
Soil Organisms
Decomp. &/or Storage
Animals
Man
Decomp. &/or Storage
Aquatic Organisms
Man & Animals
Decomp. &/or Storage
Products
Decomp. &/or Storage
Excreted
Decomp. &/or Storage
Decomp. &/or Storage
Excreted
Excreted
Sewage
Decomp. &/or Storage

and metabolites. No complete study of this kind has been undertaken as yet, although we do get some useful suggestions from the existing literature. We will, therefore, examine some of these in an attempt to further identify the problem and its hopeful solutions.

Chlorinated Hydrocarbons. DDT and its relatives have probably been subjected to the closest scrutiny of all of the chlorinated hydrocarbons. It is logical, therefore, that more literature on this subject exists and perhaps also, the greatest confusion. A great variety of microorganisms have been examined for their ability to degrade DDT. Many bacteria isolated from soils, water, sediments or intestinal contents have the ability to at least convert DDT to DDD. Yeast and actinomycetes also have this ability to a limited extent but the fungi are conspicuous for their inability to attack the parent molecule. Degradation of DDT appears to be enhanced by anaerobic conditions - unfortunately, many of the analyses have been conducted with whole soil or natural environmental media so that no identity of the organisms have been accomplished. Data of this type shows (depending upon the soil type and the original floral and faunal composition) that after four weeks of incubation (30°C) as much as 62% of the original

DDT had been converted to DDD, 34% remained as the parent DDT, and only 4% was degraded to other products. Table 1 lists some of the decomposition products of dechlorination of the original molecule. (6)

TABLE 1-C

DECOMPOSITION PRODUCTS OF DDT ISOLATED FROM
SOIL AFTER ANAEROBIC INCUBATION FOR TWO WEEKS
AND FOUR WEEKS

Product	Recovery (in micrograms) after	
	2 weeks	4 weeks
DDA	0.37	0.51
BA	.24	.59
Kelthane	.15	.61
DBP	.39	.64
DDD	7.1	35
DDT	62	19
DBM	0.09	0.03
DDE	.19	.25
Total	71	57

However, since the major product of the dechlorination DDT (TDE), although much less toxic to mammals than the original compound, is still nevertheless extremely toxic to some aquatic organisms. Field studies have indicated that under very heavy applications, DDT has persisted, up to 39% of the application after 17 years. (7)

Evidence from other works indicates that the dechlorination product DDD, while arising as the result of microbial action, is itself more inhibitory on the growth of these organisms at higher concentrations than DDT. Table 2 lists some of the forms examined as the possible inhibitory effects on nutrient agar. (8) At 100 ppm, DDT and DDD had little effect on microorganisms in soil. It is suggested that while no total effect was observed in short term experiments, shifts or changes in microbial species composition in soil could occur.

TABLE 2-C

INHIBITORY EFFECT OF DDT AND DDD ON MICROORGANISMS IN NUTRIENT AGAR

Microorganism	Control	DDT (p.p.m.)			DDD (p.p.m.)		
		1	10	100	1	10	100
Bacteria							
Agrobacterium tumefaciens	–*	–	–	–	–	++	++
Bacillus licheniformis	–	–	++	++	–	++	++
B. subtilis	–	–	–	–	–	++	++
Corynebacterium fusciens	–	+	++	++	–	++	++
Escherichia coli	–	–	–	–	–	–	–
Pseudomonas angulata	–	–	–	–	–	–	–
P. fluorescens	–	–	–	–	–	–	–
Rhizobium trifolii	–	–	–	–	–	–	–
Serratia marcescens	–	–	–	–	–	–	–
Xanthomonas phaseoli var. *sojensis*	–	–	–	–	–	–	–
Actinomycetes							
Actinoplanes philippinensis	–	–	+	++	–	++	++
Micromonospora sp.	–	–	++	++	–	++	++
Nocardia erythropolis	–	–	–	–	–	–	+
Streptomyces aureofaciens	–	–	+	+	+	++	++
S. griseus	–	–	+	++	–	++	++
S. lavendulae	–	–	–	–	–	–	–
S. scabies	–	–	–	–	–	+	++
S. venezuelae	–	–	–	+	–	+	++
S. viridochromogenes	–	–	–	–	–	++	++
Streptosporangium roseum	–	–	++	++	–	++	++

* –, no inhibition of growth; +, 50% inhibition; ++, complete inhibition.

The fungi tested were Aphonomyces euteiches, Fusarium solani, Glomerella cingulata, Helminthosporium victoriae, Mucor ramannianus, Penicillium frequentans, Pythium ultimum, Rhizoctonia solani, Trichoderma viride and Verticillium albo-atrum. None of the 10 fungi was sensitive to either DDT or DDD at concentrations up to 100 p.p.m. except for M. ramannianus, which was partially inhibited by DDD at 10 and 100 p.p.m.

Anaerobic dechlorination of DDT to DDD, as well as some other water soluble products, have been identified (6). Soil microorganisms were responsible, since no degradation was detected in sterile soil.

Adaptation to DDT in natural populations was observed to vary with the source of organism and, more particularly, with the recent prior exposure to other organochloride pesticides. Colonies grown from highly chlorinated tap water were only one percent accumulated; polluted surface water, two to seven percent; garden soil, 60-70 percent and nursery soil, recently treated with endosulfan, lindane, sumarin or captan, 80 to 95 percent. The ubiquity of DDT in the global environment is thought to be responsible for the large proportion of DDT-resistant bacteria in soil samples. (9)

The lack of dechlorination of DDT by some bacteria under anaerobic conditions may be due in part to the lack of reduced cytochrome oxidase under these conditions. This may explain the relative persistence of DDT under aerobic conditions. (10)

Studies of the anaerobic degradative potential of activated sludge mixtures on chlorinated hydrocarbons showed some degree of degradation of all compounds tested. Lindane was clearly the least persistent compound with heptachlor, endrin, DDT, DDD, aldrin, heptachlor epoxide and dieldrin in order of increasing persistence. It is suggested that wherever natural anaerobic bottom conditions exist, the possibility for some degree of degradation could occur. Heat and increased biological activity as well as the nature of the anaerobic bottom were listed as possible variables, although the 35°C temperatures used in the studies are really achieved by natural waters. Activity at 20°C was correspondingly much less. These results indicate that DDT degrades to DDD very rapidly under anaerobic conditions, but resisted conversion under aerobic circumstances. Thus, spring and summer applications of DDT and subsequent entry into waterways could be expected to follow several general paths. One, if strongly bound to clays or particulate organic matter, would find the product persisting until the silt or detrital load was deposited along stream courses (bottoms of pools, deep backwaters) where some anaerobic degradation could occur. Second, if transported to lakes or ponds coincident with spring overturn and increasing biological activity, we might expect the original DDT to remain as DDT in the oxygen rich environment until carried to the bottom on silt or incorporated into dead bodies of planktonic detriters. As the season progressed and stratification occurred, the bottom would become a progressively more favorable medium for degradation.

It was also suggested, (as others have), on the basis of these studies, (above) that the conversion of DDT to DDD requires a reducing cofactor. (4) Such a factor for the mediation of the conversion is Fe(II) reduced cytochrome oxidase. (10)

Studies with Aerobacter aerogenes have allowed a partial elucidation of the metabolic pathway of degradation of DDT. It appears that discrete enzymes are involved in each step. (11, 12) The scheme is presented in Figure 2.

Dichlorodiphenylacetic acid (DDA) appears to be a common metabolite of vertebrate DDT degradation. Further biodegradation by the above bacterium produced the most highly degraded product of DDT yet reported, DBP (Figure 3). Further microbial breakdown is not precluded, but not yet identified. (13)

In vitro degradation by fish gut contents (as well as gut contents from numerous other vertebrates) has been examined. (14, 15, 16) Discussion will be in Appendix D.

FIGURE 2-C

METABOLIC PATHWAY FOR DDT DECHLORINATION BY AEROBACTER AEROGENES (R = P-CHLOROPHENYL) (11)

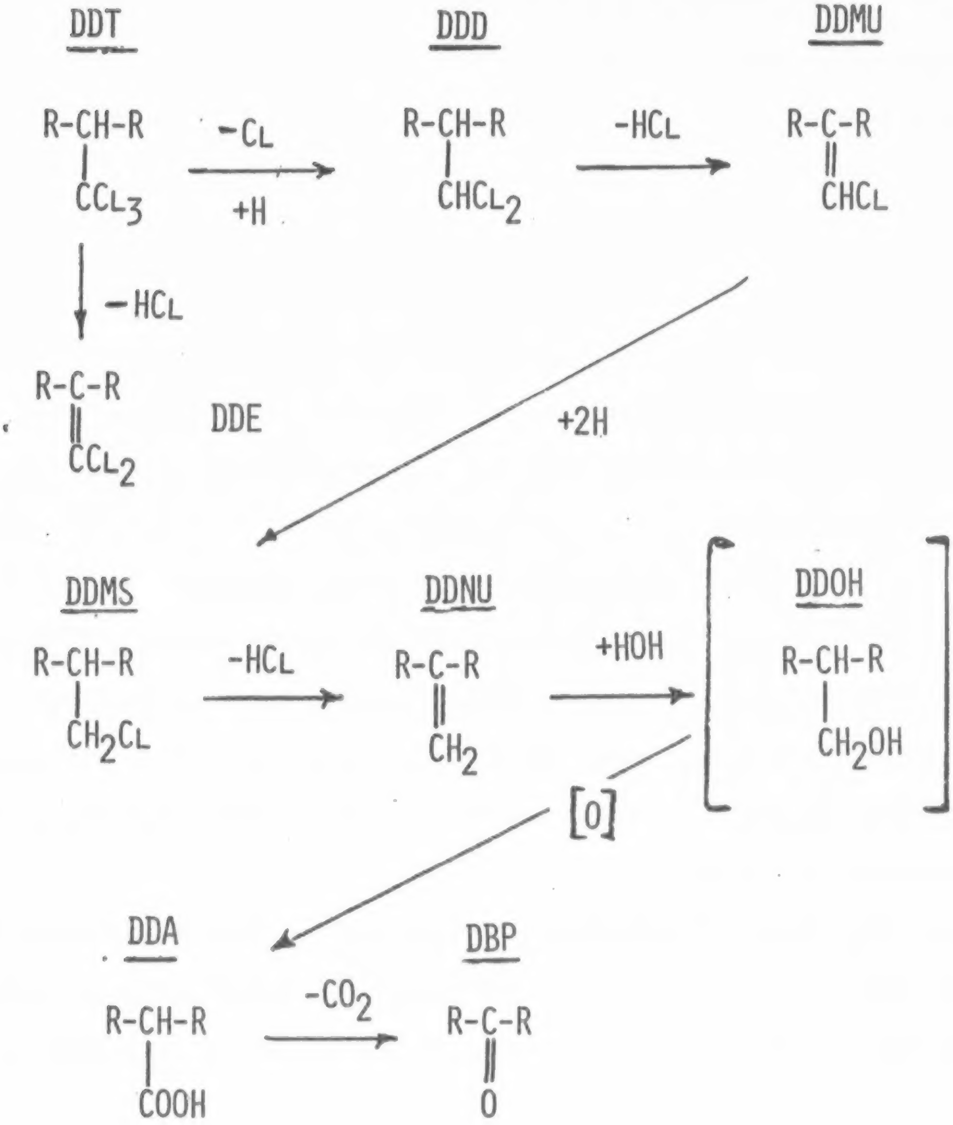
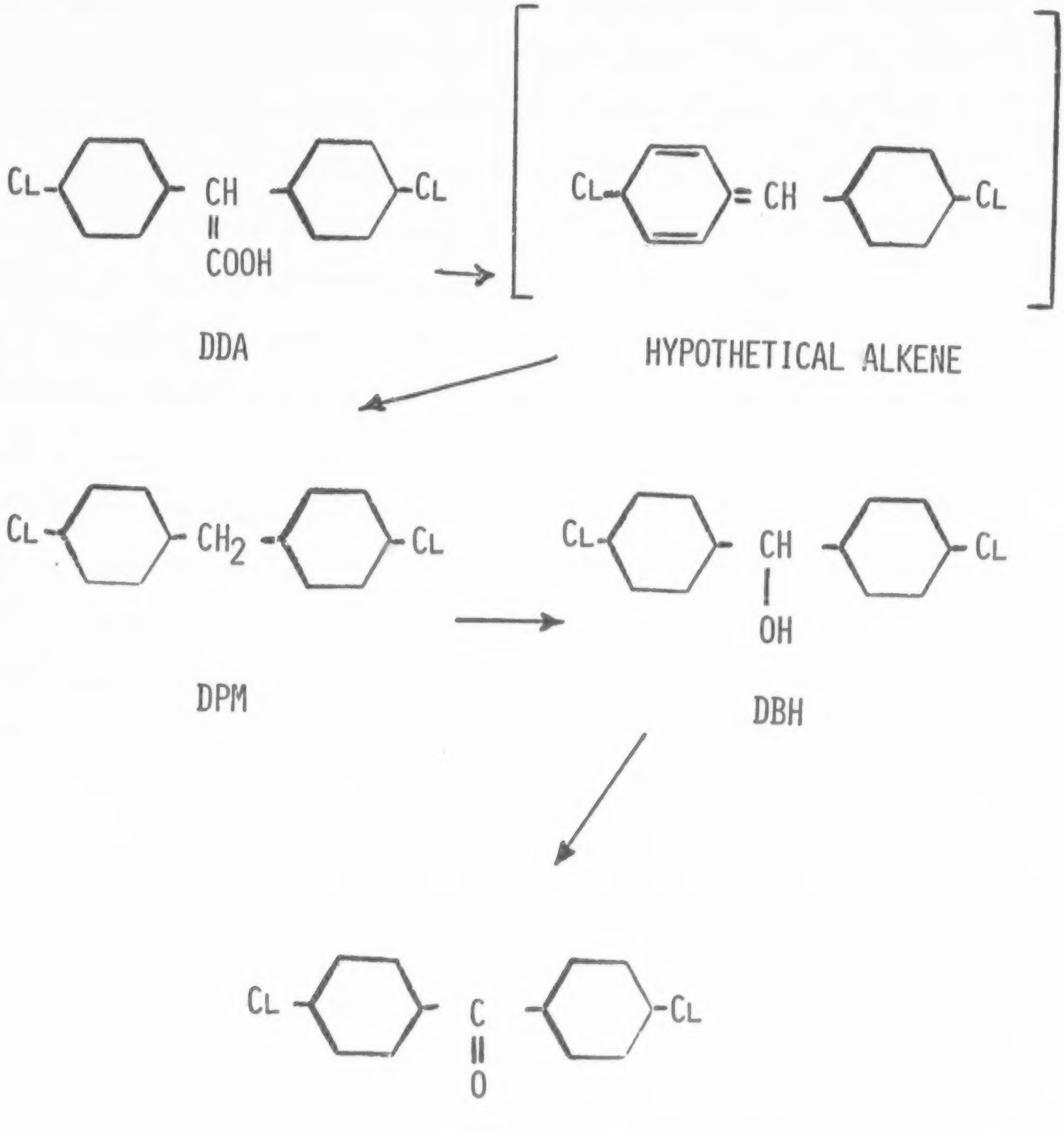

DDT
R-CH-R
CCL3
-CL
+H
DDD
R-CH-R
CHCL2
-HCL
DDMU
R-C-R
CHCL
-HCL
R-C-R
CCL2
DDE
+2H
DDMS
R-CH-R
CH2CL
-HCL
DDNU
R-C-R
CH2
+HOH
DDOH
R-CH-R
CH2OH
[O]
DDA
R-CH-R
COOH
-CO2
DBP
R-C-R
O

FIGURE 3-C

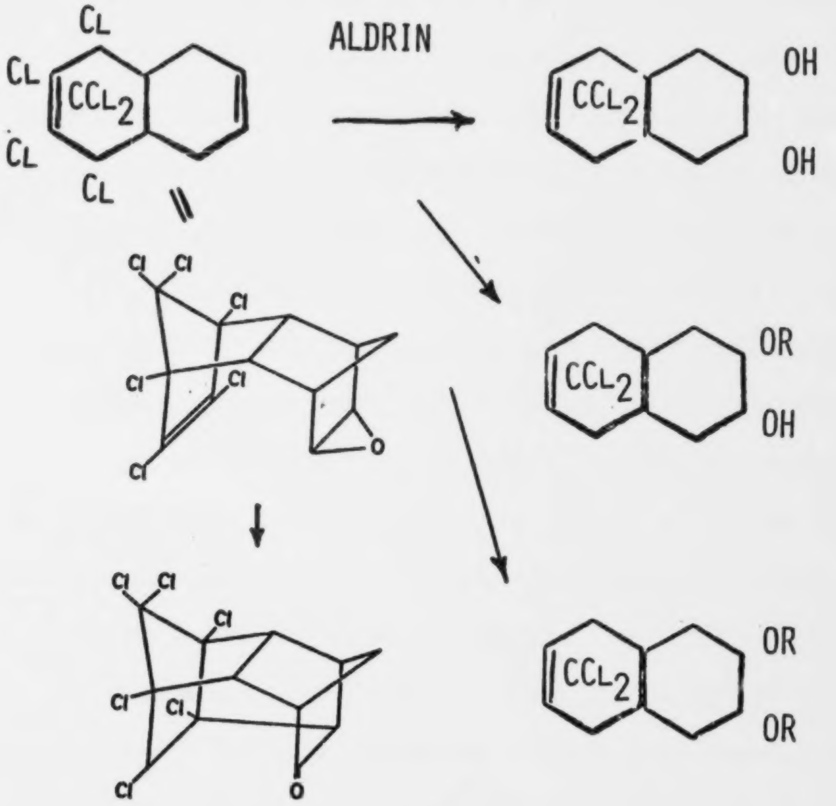
METABOLIC PATHWAY FOR DDA DISSIMILATION
BY AEROBACTER AEROGENES (12)

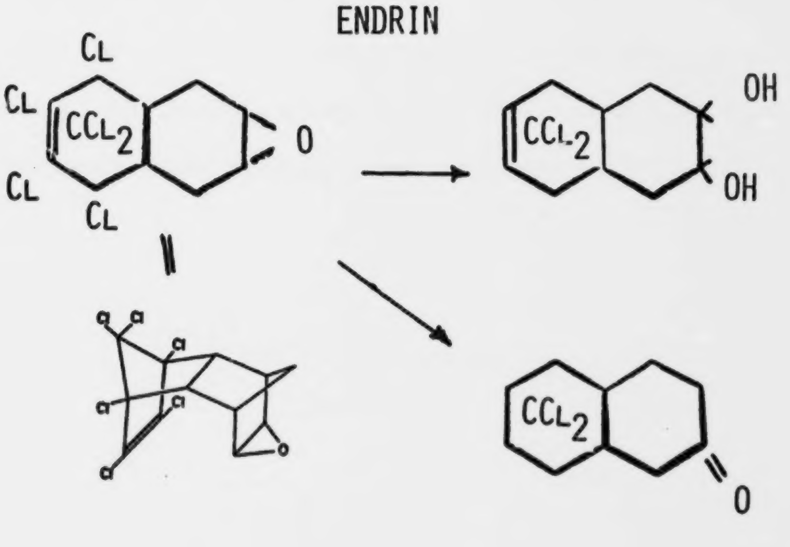

CL
CH
COOH
CL
DDA
CL
CH
CL
HYPOTHETICAL ALKENE
CL
CH2
CL
DPM
CL
CH
OH
CL
DBH
CL
C
O
CL
DBP

Considerable research has been accomplished and volumes have been written on the metabolism of aldrin, dieldrin and other diene insecticides. Although considerable voids are present as far as naturally occurring populations of animals are concerned, we do know or can infer from studies with laboratory animals what kinds of reactions can be expected and what kinds of metabolites would result from diene ingestion. We have tried to summarize some of the major metabolites in Figure 4. Several points are worthy of notice. Numerous studies in the past eight to ten years have clearly established that vertebrates (mostly mammals) and to some extent, insects (mostly Diptera) convert aldrin, heptachlor and isodrin to their epoxides *in vivo*. The alarming nature of these compounds is seen in the fact that they are generally more toxic than their parent compounds. For years, it was thought these epoxides were resistant to further attack. More recently, it has been observed by an increasing number of works that the epoxides are subject to hydrolytic attack resulting in more hydrophilic and less toxic metabolites. These metabolites are also, by virtue of this rearrangement, generally more water soluble, which has facilitated their eliminating by the renal route. It would appear, therefore, that generally

FIGURE 4

POSSIBLE METABOLITES OF ALDRIN AND ENDRIN (17)


ALDRIN
CL
CL
CL
CL
CCL2
Cl
Cl
Cl
Cl
Cl
Cl
O
OH
OH
OR
OH
OR
OR


ENDRIN
CL
CL
CL
CL
CCL2
O
Cl
Cl
Cl
Cl
Cl
Cl
O
OH
OH
O

the capacity for oxidative enzymatic alteration of the dienes may be much more widespread in the animal kingdom than previously imagined. The situation with rats (and probably other laboratory animals as well) is summed up by the following; 1) chronic feeding of dieldrin produces approximately equal amounts of metabolites in feces and urine (70 and 95%, respectively) in both males and females. The rate of conversion, however, is considerably lower in females. Telodrin and heptachlor yield the reverse result. Saturation is reached in males after fifty days but only after 200 days in the female, and 2) when endrin is fed (0.4ppm daily) a steady state storage is reached in five to six days for both males and females, thus aldrin, dieldrin and endrin, when applied in daily constant dosages, reach a saturation level at varying periods of time, depending on the compound and the sex of the receiving animal. This has also been shown for DDT and methoxychlor, 3) when daily feeding is stopped, a declining half life curve is obtained of ten to eleven days for males and 200 days for females. Endrin half life is 200 days for males and three or four days for females. (17, 18) It might therefore be inferred that females would be expected to show a greater affect than males. Certainly the demonstrated involvement of microsomal enzyme systems in both diene degradation and steroid metabolism would suggest that reproductive failure or alteration in females should be more pronounced in females than in males. Such a suggestion is supported by the work with beagle dogs (19) and strongly indicated in work with both penned and natural raccoon populations. (20) The fact that rabbits appear to have a far greater ability to degrade these compounds than other mammals, is reflected in controlled studies with cottontail rabbits, employing agricultural application levels. Here, no alteration of reproductive success was noted. (21) A point should be made here, we think, for this clearly indicates the inadequacy of some of our testing procedures. The rat, mouse and rabbit, while demonstrably adequate for many pharmacodynamic studies, may not be adequate for studies dealing with pesticides due to the rather greater facility with which those animals metabolize the pesticide compounds. We have found no adequate study of comparable feeding and metabolite recovery for aquatic organisms, especially fishes. Although such studies would be relatively easy to accomplish, they have not been done and we are left with data from loading experiments where residue levels are tested from a population of sample animals some time after exposure. Even this procedure has not been carried through far enough to generate sufficient data to allow generalizations to be made.

Another point which might be made at this time is that of what kinds of data do we really need or want to have (and as a consequence, what kinds of research activity should be funded). It appears to the contractor that far too many of the field and laboratory studies in the past have concentrated on the gathering of residue levels for their own sake. These, then, become relatively useless numbers lacking a reference framework with which to make valid predictions.

Photodieldrin, previously thought to be a chemical degradative product of the action of sunlight on dieldrin, has recently been shown to arise from various sources as a metabolite of microorganism activity. Photodieldrin is of concern as an environmental contaminant because of its greater toxicity to many living forms. Microorganisms were isolated from dieldrin contaminated soils, lake water, lake bottom muds, rat intestines and rumen stomach contents, which showed the ability to convert dieldrin to photodieldrin. Of concern is the fact that soils and lake bottom silt showed the greatest number of different organisms capable of this transformation, while the lake bottom material showed over 50 percent of the isolates had this ability. Photodieldrin was the major metabolic product from both soil and bottom sediments. (25) In addition to photodieldrin, isolates have been found which created hitherto unreported ketones, an aldehyde and an alcohol derivative of dieldrin. (22)

The most common and prevalent hydrolysis product of dieldrin appears to be 6,7 dihydroxydihydroaldrin. The trans form was found to be the main metabolite of the urine of rabbits; which proved to be 1/2 to 1/16 as toxic to mice as the parent compound. (17) On the basis of chromatographic separation, chemical behavior and infrared and mass spectra, the structures shown in Figure 4 have been proposed.

Recently, two as yet unidentified metabolites have been found in livers of the sailfin mollie. (23) These metabolites are thought to be produced in the liver of these fish and not by intestinal microflora. All indications are that they are similar to some of the previously described hydrophilic metabolites of dieldrin found in mammals. These compounds were more polar than dieldrin which has caused these authors (23) to suggest partial dechlorination. The data presented (chromatograph chart) also suggests that one of the metabolites is produced at a greater rate than the other when fishes are allowed to pick up dieldrin from the water. Marine fishes drink water to maintain their osmolality - thus, the possibility that the products were produced by intestinal microflora, transported across the gut and preferentially stored (or altered further) by the liver cannot be precluded.

The common and ubiquitous bacterium Aerobacter aerogenes has been demonstrated to apparently degrade dieldrin to 6,7,trans-dihydroxydihydroaldrin in vitro. (24) Numerous authors have demonstrated several other ubiquitous species of Pseudomonas and Bacillus. Many of these studies are not particularly helpful in defining degradative processes since they merely show the degradation but have not identified the metabolites.

No conversion of dieldrin has been shown to occur in fungal preparations by some authors. On the other hand, growing cultures of Aspergillus flavus have yielded hydrophilic metabolites when treated with aldrin, telodrin, chlordane, heptachlor and endrin. (17) It would appear that this fungus, when treated with both aldrin and telodrin was capable of producing metabolites, and releases them back into the culture medium at a rapid rate. Chlordane, heptachlor and endrin metabolites, on the other hand, while produced in large or larger quantities, were selectively retained by the growing hyphae.

Young cabbage plants were also found to degrade endrin to two compounds: a more hydrophilic main metabolite and a product which appears similar to the ketone (Figure 4). The pesticide, applied to leaves, produced concentrations of metabolites in leaves, stalks, roots and soil of 7, 26, 40 and 51 percent respectively. The metabolites were thus translocated downward and extruded from the growing plant. (17) Various algal species have been identified which will take up pesticides from the water. To what extent they retain the parent compound and/or possible metabolites is completely unknown at present. It can be seen that measurements of residue levels remaining inside the growing cells are potentially misleading to the total environmental assessment, if metabolites are eliminated due to "clean-up" procedures or if metabolites are differentially retained or eliminated to the environment.

The conversion of endrin to ketoendrin was found to be common throughout twenty-five soil isolates which degraded endrin (Figure 4). (25) The ketone and alcohols seem to be common to partial dechlorination and early degradation of chlordane, heptachlor, teledrin, aldrin and dieldrin. Figures 5 and 6.

Photoconversion of solid and dissolved dieldrin has recently been shown to elaborate a variety of compounds. Since (biological) translocation is possible with this compound, photoconversion at the leaf surface is a real possibility. (26) Figure 7.

Bean and pea root or seedling preparations oxidized aldrin to dieldrin and to a small quantity of aldrin diol. The preparations also converted isodrin to a compound chromatographically similar to endrin ketone. Corn preparations were ineffective in these transformations and heptachlor was not effected in these studies. (27)

To what extent aquatic plants and algae, especially diatoms, would affect such transformations in unknown at this time. It is known and will be discussed later that the compounds are accumulated by both filamentous and single celled algae.

Metabolism of trans-chlordane in the rabbit has been

FIGURE 5

METABOLITES OF ALDRIN AND ISODRIN (18)

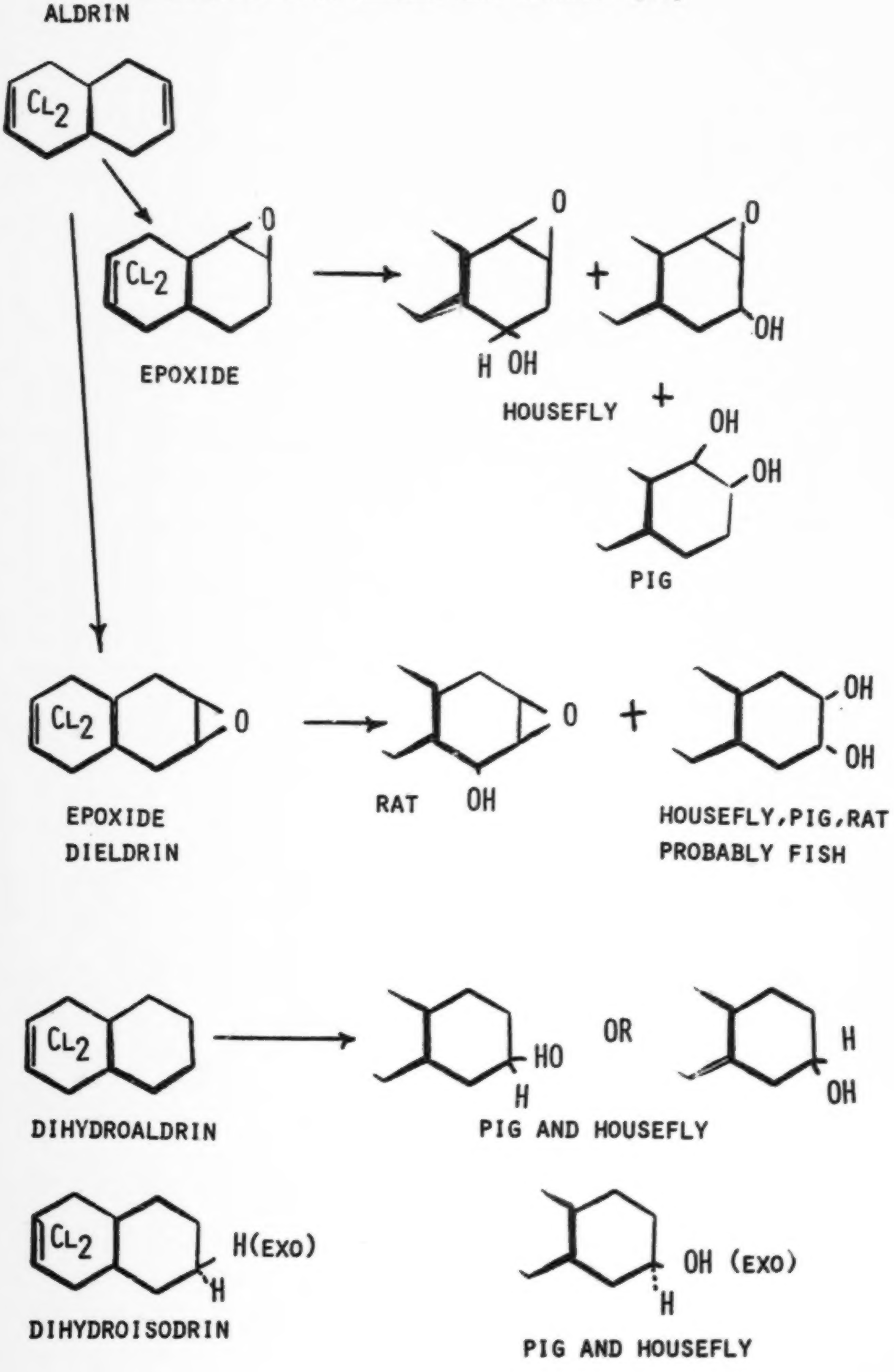

ALDRIN
CL2
CL2
O
EPOXIDE
O
H OH
+
O
OH
HOUSEFLY
+
OH
OH
PIG
CL2
O
EPOXIDE
DIELDRIN
O
RAT
OH
+
OH
OH
HOUSEFLY, PIG, RAT
PROBABLY FISH
CL2
DIHYDROALDRIN
HO
H
OR
H
OH
PIG AND HOUSEFLY
CL2
H(EXO)
H
DIHYDROISODRIN
OH (EXO)
H
PIG AND HOUSEFLY

FIGURE 6

METABOLITES OF TELODRIN, HEPTACHLOR
AND PHOTOCONVERSION OF DIELDRIN (18, 26)

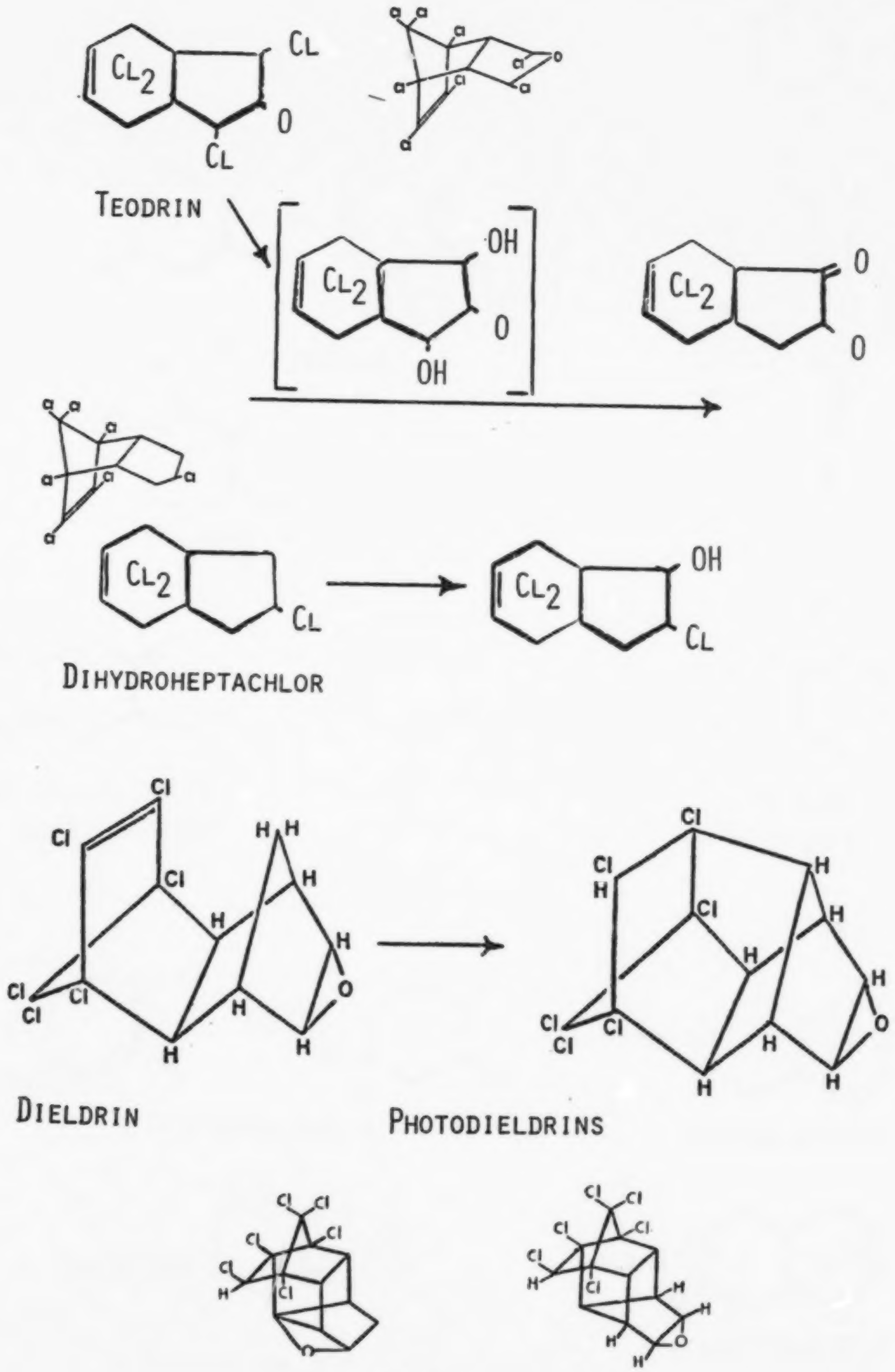
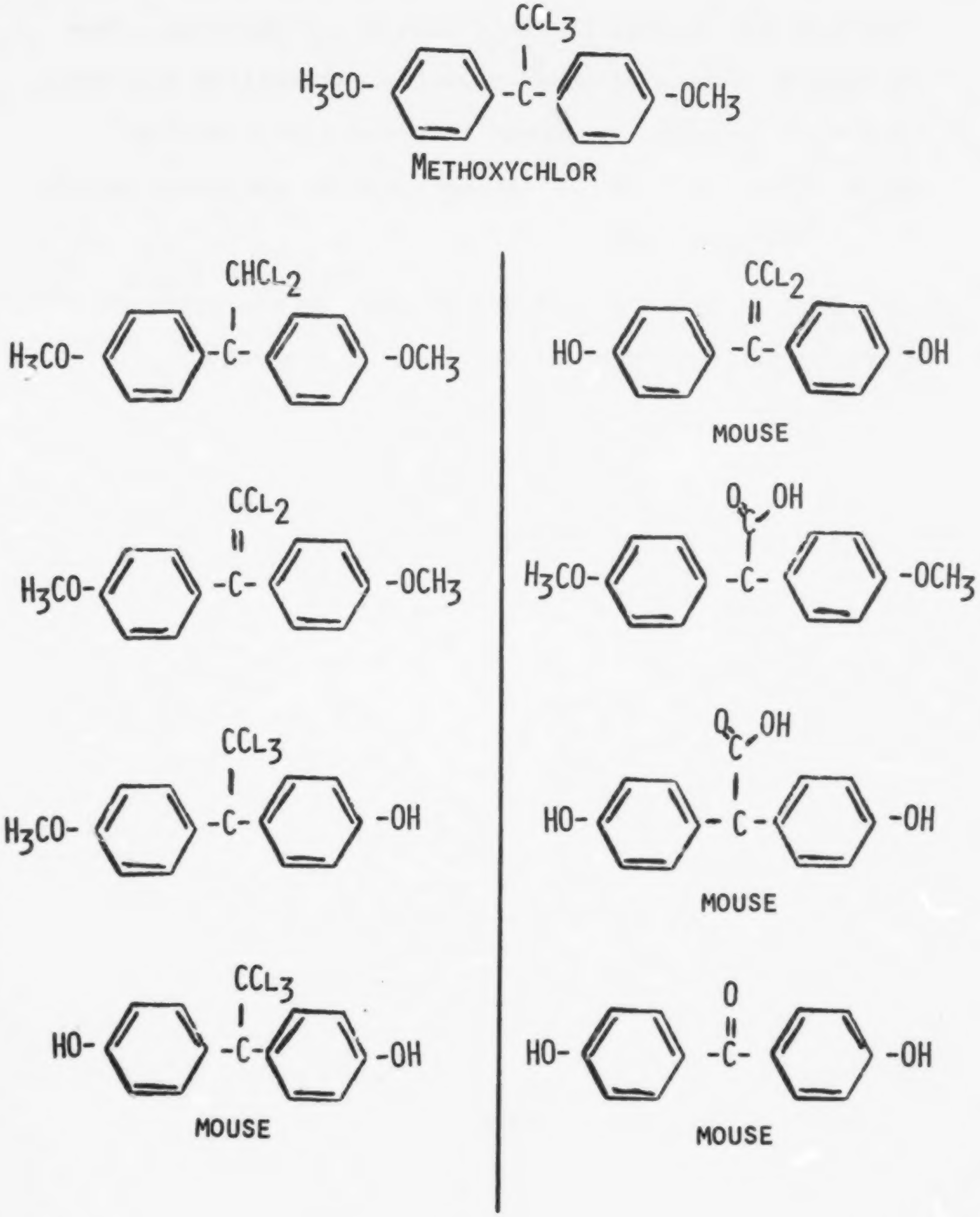

CL
CL2
O
CL
TEODRIN
OH
CL2
O
OH
CL2
O
O
CL2
CL
CL2
OH
CL
DIHYDROHEPTACHLOR
DIELDRIN
PHOTODIELDRINS

FIGURE 7

IDENTIFIED METABOLITES OF METHOXYCHLOR (32)

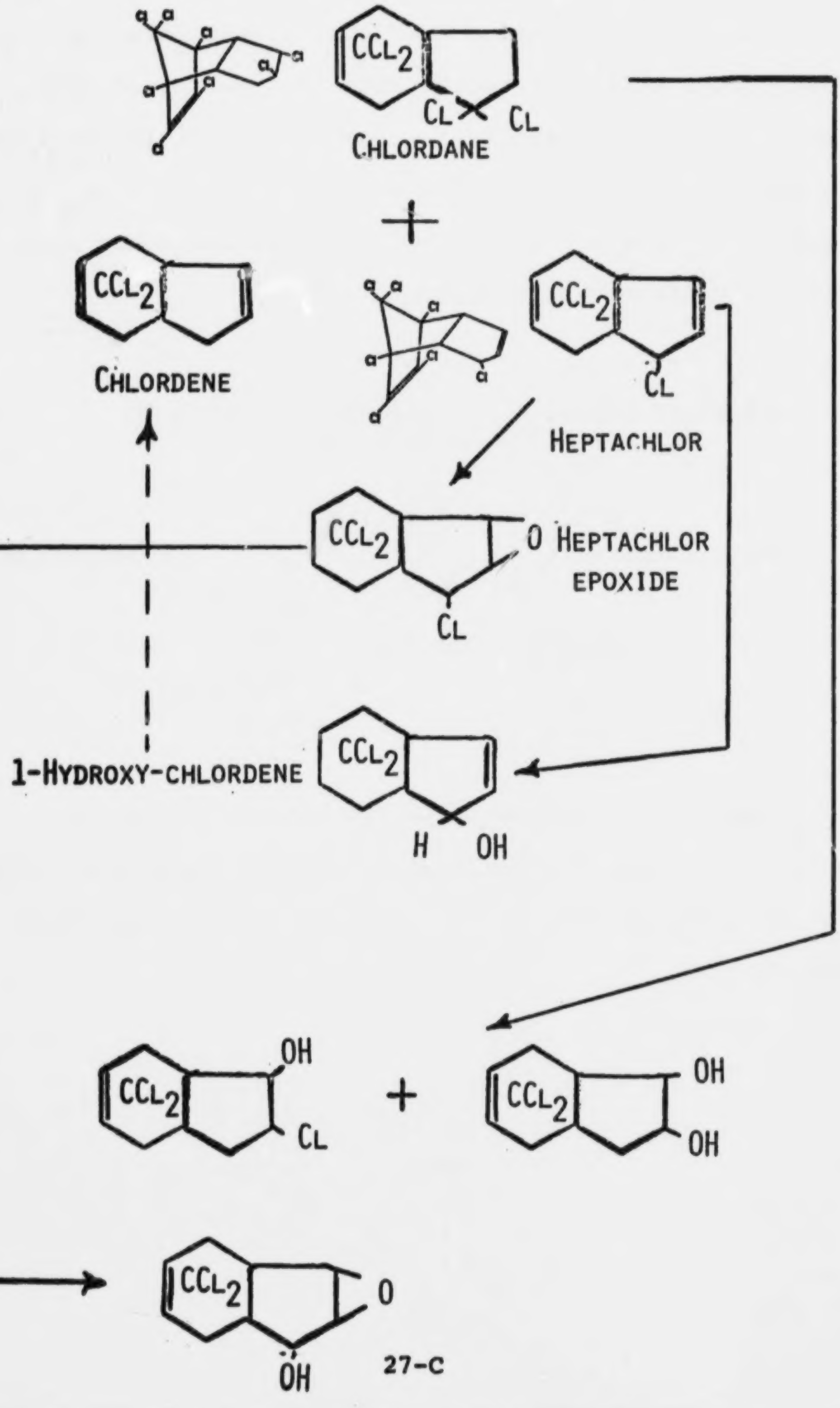

METHOXYCHLOR
MOUSE
MOUSE
MOUSE
MOUSE

examined and one main metabolite identified, the other proposed. After extended feeding periods, it was found that 70 percent of the administered daily dose was eliminated in the urine (daily) as metabolic products. Relatively small storage in fatty tissue was observed. The structure as well as other possible metabolites are shown in Figure 8. (28) It should be noted that technical grade chlordane is a mixture of isomers, including heptachlor, which is covered in Figure 8.

Thus it appears that one or both of the chlorine atoms of the cyclopentane ring may be removed.

FIGURE 8

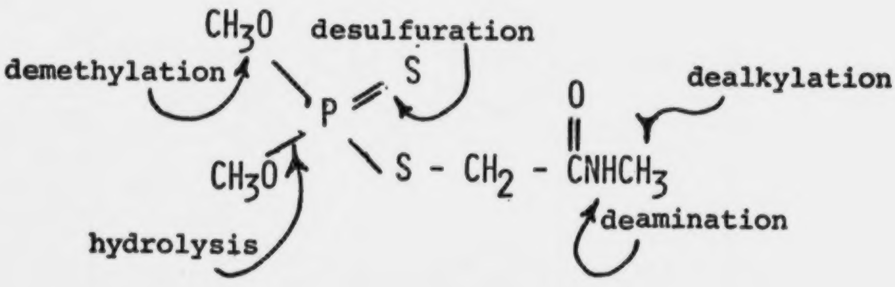
COMPOSITION AND METABOLITES OF TECHNICAL CHLORDANE
(18 and various)


CCl2
Cl
Cl
CHLORDANE
+
CCl2
CHLORDENE
CCl2
Cl
HEPTACHLOR
CCl2
O
HEPTACHLOR EPOXIDE
Cl
1-HYDROXY-CHLORDENE
CCl2
H
OH
OH
CCl2
Cl
+
CCl2
OH
OH
CCl2
O
OH

Organophosphorus compounds. Diazinon, malathion, parathion and dimethoate all appear to be subject to essentially the same sites of attack and degradation (Figure 9). (29) Hydrolysis at several sites, desulfuration, nitro-reduction and demethylation are common. Most of the critical studies have been performed with rat liver enzyme preparations but sufficient information is available to suggest that microsomal mixed function oxidase systems are operative in fishes and other cold blooded vertebrates as well.

FIGURE 9

SITES OF CHEMICAL AND BIOLOGICAL ATTACK ON ORGANOPHOSPHORCUS COMPOUNDS


CH3O
desulfuration
demethylation
S
P
O
dealkylation
CH3O
S - CH2 - CNHCH3
deamination
hydrolysis

The relative degree of activation of P=S to P=O observed between different animal groups forms the basis for an understanding of the relative toxicity of these compounds.

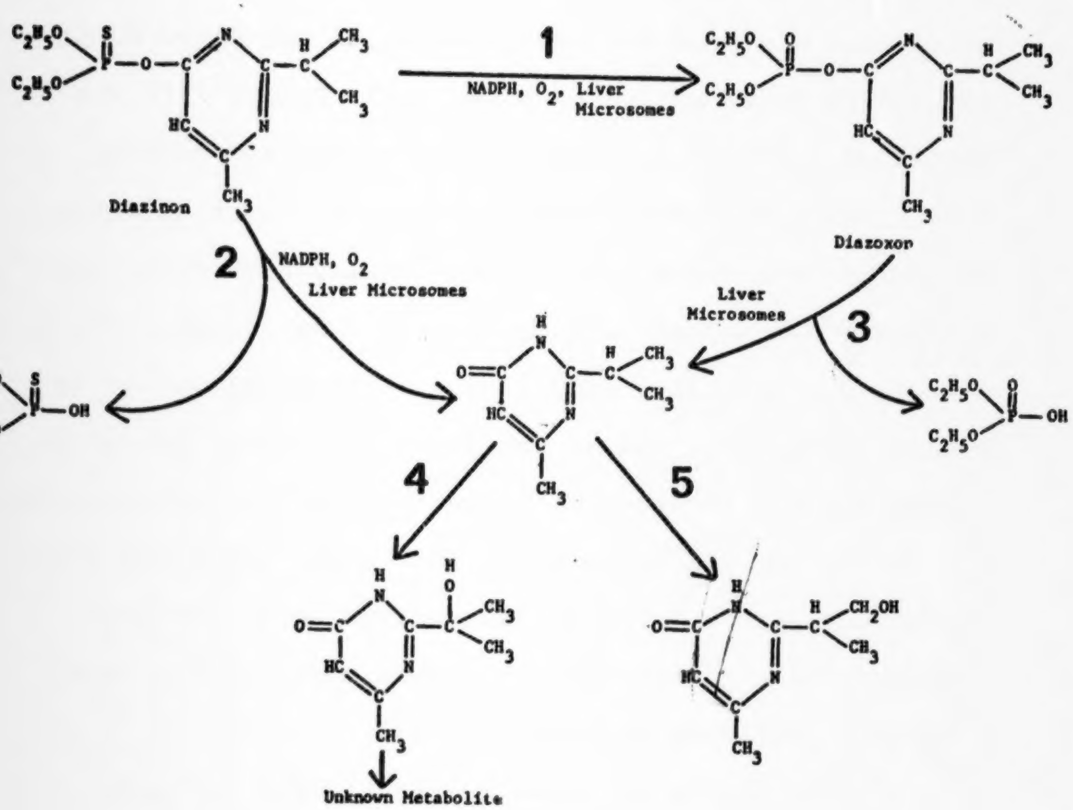
It appears that the oxygen analog of these compounds is considerably more toxic than the parent. Toxicity of the numerous metabolites is variable. The mixed function enzymes are generally NADPH and oxygen requiring, so that poorly nourished and/or stressed animals (like low ambient dissolved oxygen) would probably be much more susceptible to harmful effects than healthy unstressed fishes. The microsomal diazoxon degrading enzyme is not NADPH dependent and is quite active in rats. (30) Figure 10 The fact that diazinon or diazoxon are slowly degraded by insect mixed function enzyme systems is important since such organisms could carry a potentially high reservoir of this organophosphate to be ingested by fishes. While diethyl phosphothioic acid is not particularly toxic to aquatic organisms, one of the other hydrolysis products, p-nitrophenol, is known to be quite toxic to living systems.

Model bog studies suggest that under simulated natural conditions (i.e., soil, microorganisms, etc., intact) diazinon is lost from the water much more rapidly than parathion following application. (31)

The metabolism of organic insecticides has been divided into two broad groups: activation and detoxication.

FIGURE 10

PROPOSED METABOLIC PATHWAY OF DIAZINON IN THE RAT (30)


1
NADPH, O2, Liver Microsomes
Diazinon
Diazoxon
2
NADPH, O2 Liver Microsomes
Liver Microsomes
3
4
5
Unknown Metabolite

Activation is defined as the combined metabolic reactions that convert an intrinsically inactive molecule to an active compound or from one active compound to another active compound. In some cases, more than one different toxic compound may be produced. Detoxication is defined as the reaction or reactions which lead to the production of nontoxic substances. (32) While qualitatively the metabolism of the above compounds in invertebrates and vertebrates appears similar, sufficient quantitative differences exist to make the various chemicals differentially toxic to different animal groups. Thus, studies with mice and roaches show the roach to contain ten times as much malaoxon as a mouse after injection. This could mean greater activation of P=S to P=O or a greater rate of malaoxon degradation by the mammal compared to the insect. (29) Studies which would compare activation rates and rates of appearance of metabolites following dosing could help to identify degrees of toxicity for these compounds in aquatic animals but have as yet not been attempted. Dimethoate use is increasing. In insects, plants and mammals examined so far, all of the possible sites of attack have been identified. The extreme toxicity to certain insects and the relative insensitivity to mammals resulting from dimethoate exposure has been attributed to the rapid deamination to the nontoxic, ionic, carboxylic acid metabolite in mammals. (29) Further examples of organophosphorus compound degradation are indicated in Figures 11 and 12.

Malathion has been found to degrade rather completely in soil by nonbiological hydrolysis alone. Obviously, the rate of hydrolysis would be controlled by temperature, ionic strength of system, pH, presence or absence of catalytic agents. Of these, pH appears to be the more important with over 99% hydrolysis in one day and pH 11. The degradation was rapid and, depending on the soil type was found to be 50 to 90 percent in 24 hours in either sterile or non-sterile soil. (33)

Examination of hypothetical and actual systems demonstrated that of the two proposed routes (Figure 12), pathway 2 leading to the formation of intermediate V was the preferred route in their systems, since the hydrolysis 2a was observed to be much more rapid than 1a.

Such a system is seen to be analogous to that occurring in the degradation of diazinon. (Figure 10)

Fish liver enzymes tested against certain organophosphorus compounds showed variable degrading capacity. DFP and Dichlorvos were both readily hydrolyzed by en-

FIGURE 11

PARATHION AND MOST COMMON METABOLITES OR DEGRADATION PRODUCTS

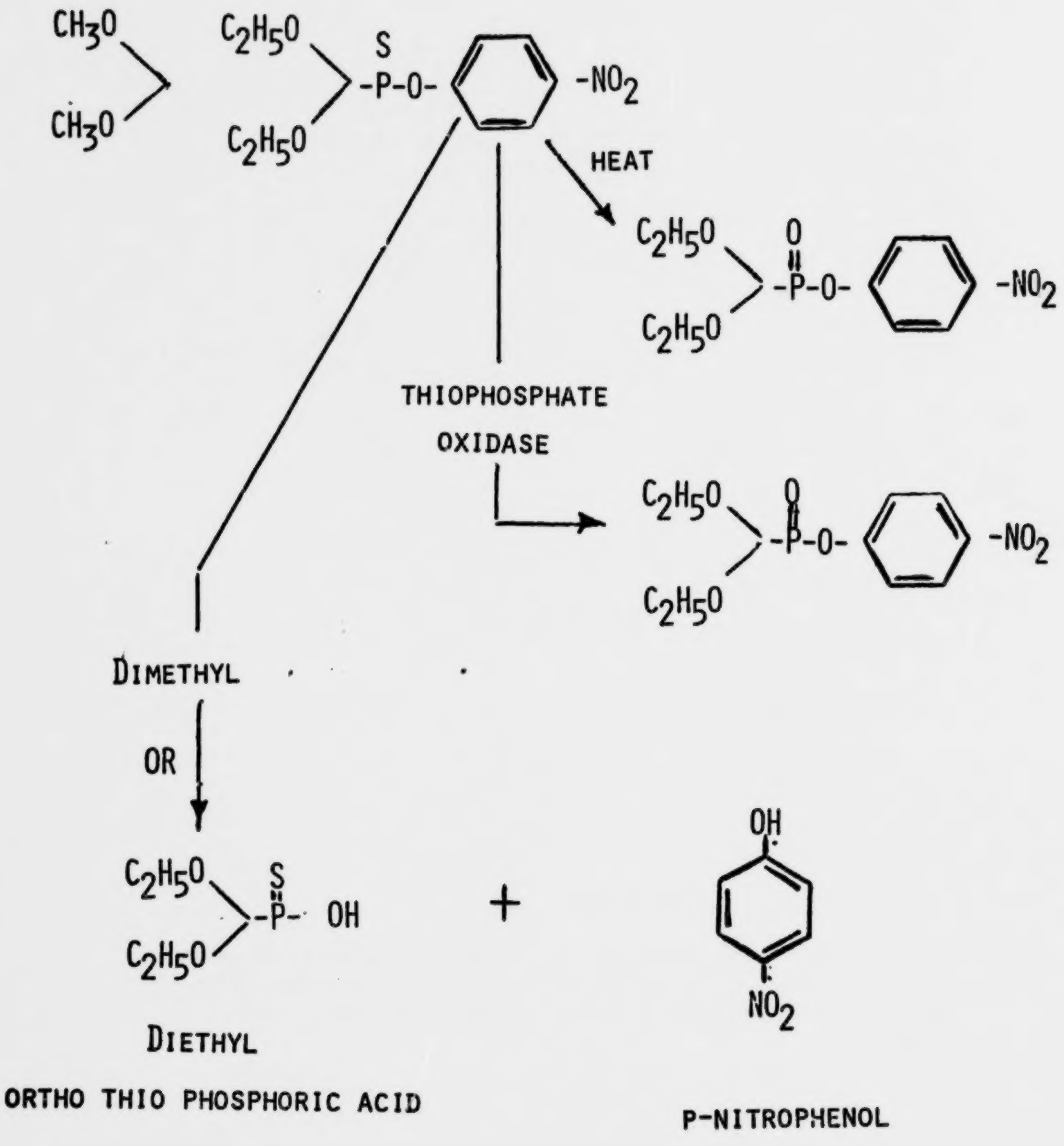
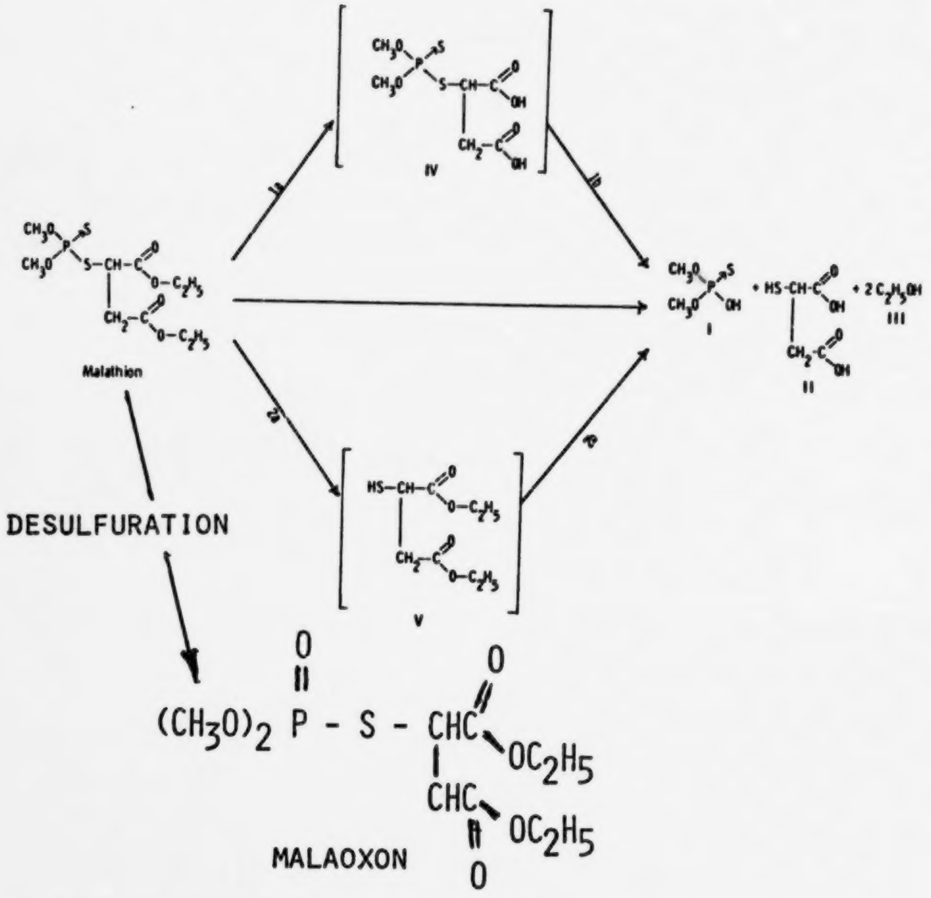

HEAT
THIOPHOSPHATE OXIDASE
DIMETHYL
OR
DIETHYL
ORTHO THIO PHOSPHORIC ACID
P-NITROPHENOL

FIGURE 12

MAJOR METABOLIC PATHWAYS OF MALATHION DEGRADATION IN SOIL (33)


IV
Malathion
I
III
II
DESULFURATION
V
MALAOXON

NOTE: Hydrolysis of malathion is rapid in alkaline media. Products depend upon pH of reaction medium. Numerous products have been identified (see next appendix).

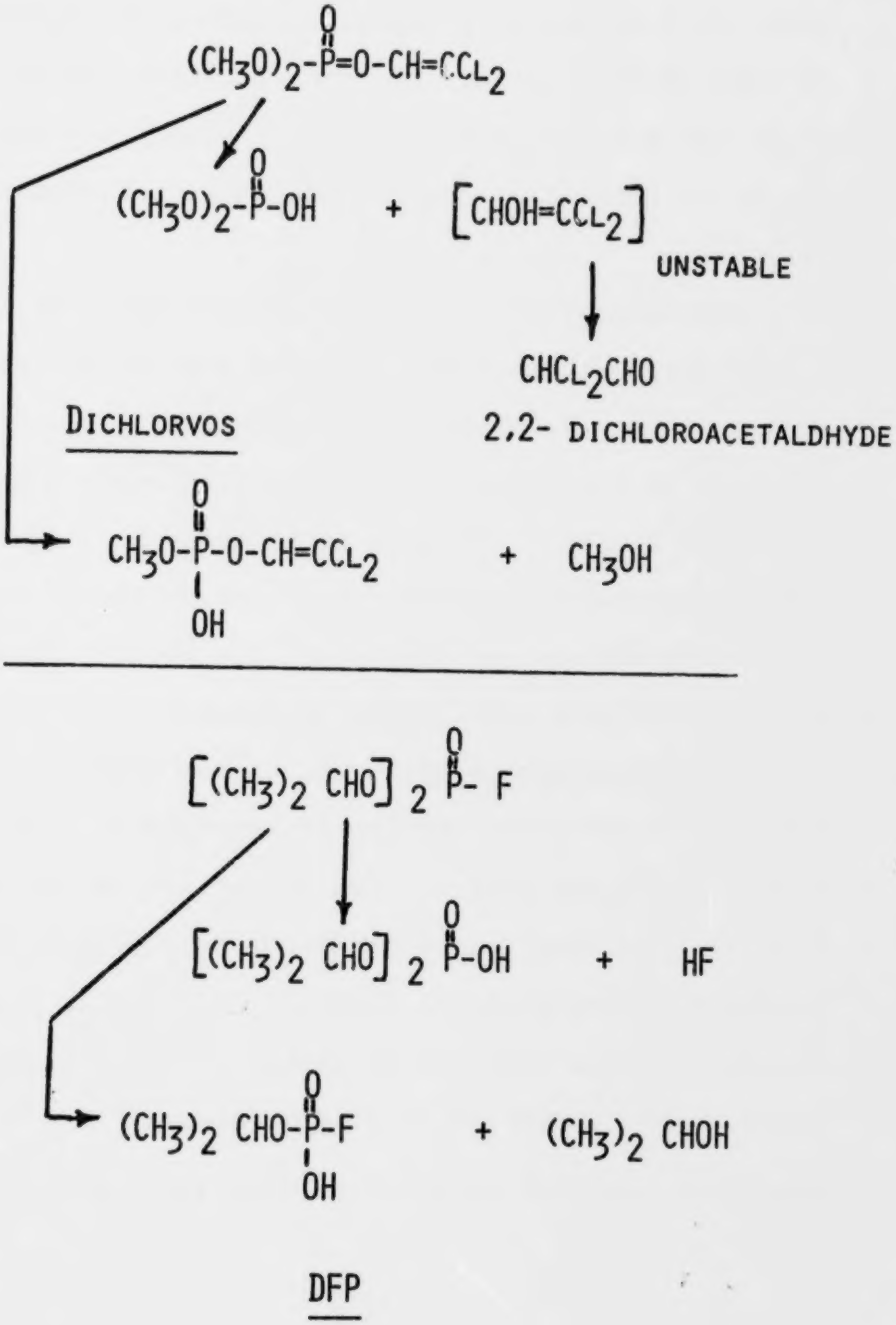
zymes from sunfish and catfish but it is of interest and possible concern that two highly toxic compounds to mammals; paraoxon and mevinphos (LD_{50} rat = 3.6-6.8 mg/kg) were not hydrolyzed by bluegill enzymes while they were, to some limited extent, by channel catfish preparations. These two species, which commonly inhabit the same waters, could, as a result, show considerable differences in their response.

The identification of metabolites from the fish liver enzyme preparations would indicate that previously enumerated systems common to mammals are operative in fishes. Hydrolysis of the P-O-vinyl bond in dichlorvos and P-O-isopropyl bonds in DFP have tentatively been identified, indicating enzymatic cleavage of the anhydride bond. Figure 13) Dealkylation and other products are not excluded but not demonstrated under these conditions.

Carbamate pesticides. The widely used carbamate insecticide carbaryl (sevin) is regarded as a relatively simple carbamate ester. Its metabolism is not simple however, for over twenty different metabolites have been recovered from mammalian systems. (32) It is rapidly metabolized and excreted by mammals; the water soluble glucuronide appearing in urine. Approximately half of the total excreted metabolites show the intact ester

FIGURE 13

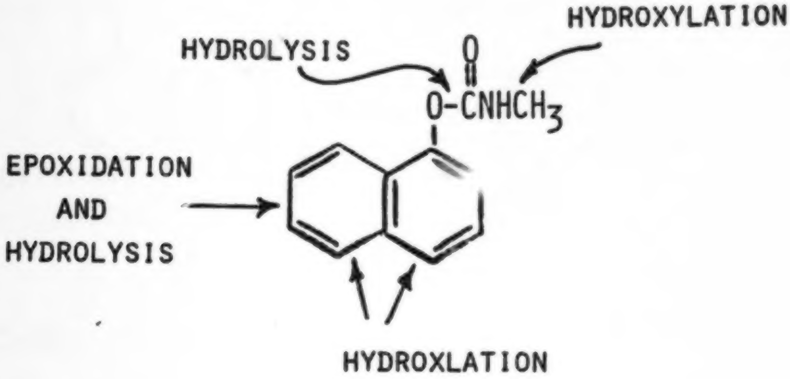
DEGRADATION OF DICHLORVOS AND DFP BY FISH LIVER ENZYMES (34)


(CH3O)2-P(=O)-O-CH=CCL2
(CH3O)2-P(=O)-OH
+
[CHOH=CCL2]
UNSTABLE
CHCL2CHO
2,2- DICHLOROACETALDHYDE
DICHLORVOS
CH3O-P(=O)(OH)-O-CH=CCL2
+
CH3OH
[(CH3)2 CHO]2 P(=O)- F
[(CH3)2 CHO]2 P(=O)-OH
+
HF
(CH3)2 CHO-P(=O)(OH)-F
+
(CH3)2 CHOH
DFP

linkage, so that even though more diverse in form, the route of basic degradation via initial hydrolysis of this linkage is vitally important. (29) Figure 14

FIGURE 14

SITES OF ATTACK FOR CARBAMATE (CARBARYL) DEGRADATION - MAMMALS


HYDROLYSIS
HYDROXYLATION
O-CNHCH3
EPOXIDATION AND HYDROLYSIS
HYDROXLATION

Other possible metabolites recovered from urine and identified by chromatographic and spectrofluorometric methods are depicted in Figure 15.

The resulting metabolites have little demonstrated toxic effect on mammals. No such recoveries have been attempted from non-mammalian vertebrate systems, however, and no data is available on the possible toxicology of presumed metabolites. The degradation in mammals appears

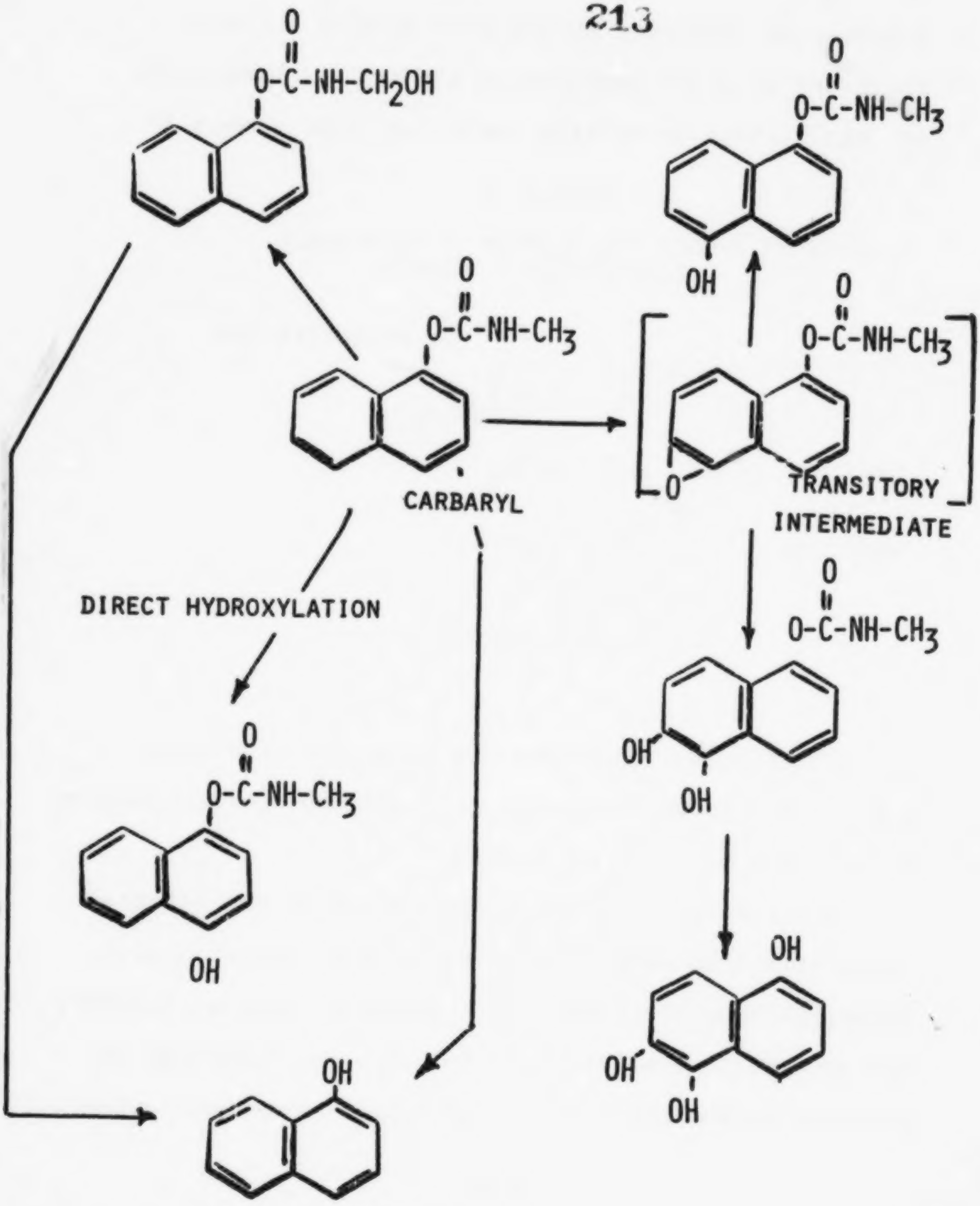
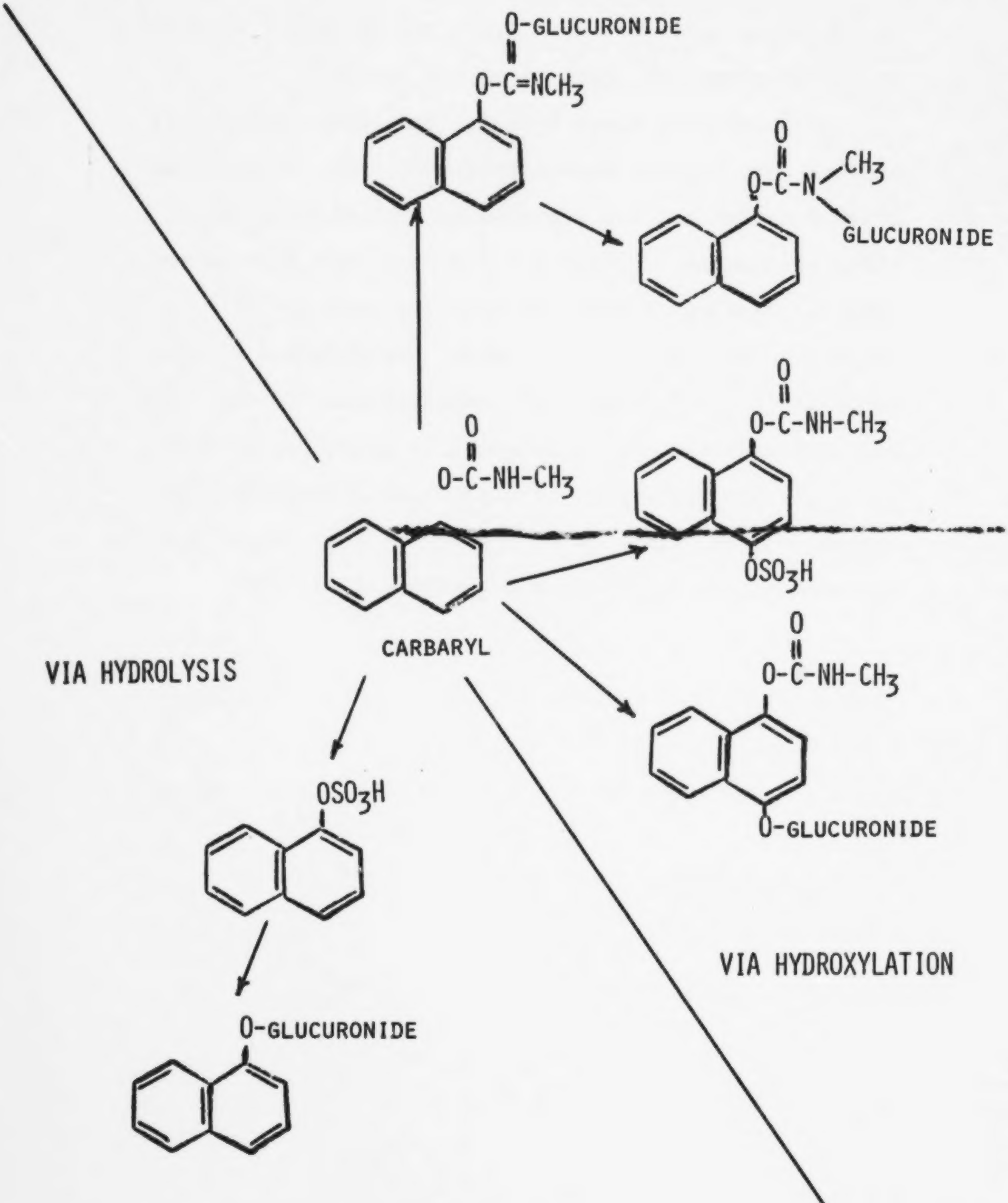

O-C-NH-CH2OH
O-C-NH-CH3
OH
CARBARYL
TRANSITORY INTERMEDIATE
DIRECT HYDROXYLATION
OH
OH
OH

FIGURE 15a

POSSIBLE METABOLITES AND HYDROLYSIS PRODUCTS OF CARBARYL (VARIOUS SOURCES) (32)

FIGURE 15b

IN VITRO METABOLISM IN MAMMALS, WITH WATER SOLUBLE GLUCURONIDES AND/OR SULFATES OF CARBARYL (32)


O-GLUCURONIDE
O-C=NCH3
O
O-C-N
CH3
GLUCURONIDE
O
O-C-NH-CH3
O
O-C-NH-CH3
OSO3H
CARBARYL
VIA HYDROLYSIS
O
O-C-NH-CH3
O-GLUCURONIDE
OSO3H
O-GLUCURONIDE
VIA HYDROXYLATION

typical of that mediated by mixed function microsomal oxidases and thus we might expect the degradative route in fishes and other aquatic vertebrates to be similar, if not identical. The hydrolysis may be either enzymatic or by non-enzymatic, base-catalyzed means.

2-iso-propoxyphenyl N-methyl carbamate (Baygon) is another very popular carbamate insecticide. Microsomal mixed function oxidase degradation is indicated as in other carbamates. Houseflies and rats both degrade the compound rapidly; the rat eliminating over 75% of administered dose within 24 hours. Degradation of this compound gives an example of O-dealkylation of the ether bond. A wide variety of products is possible, as with carbaryl, and obviously, have not been identified from fishes or other aquatic vertebrates at this date. Nothing is known of the toxicity of the metabolites. (32)

Herbicides

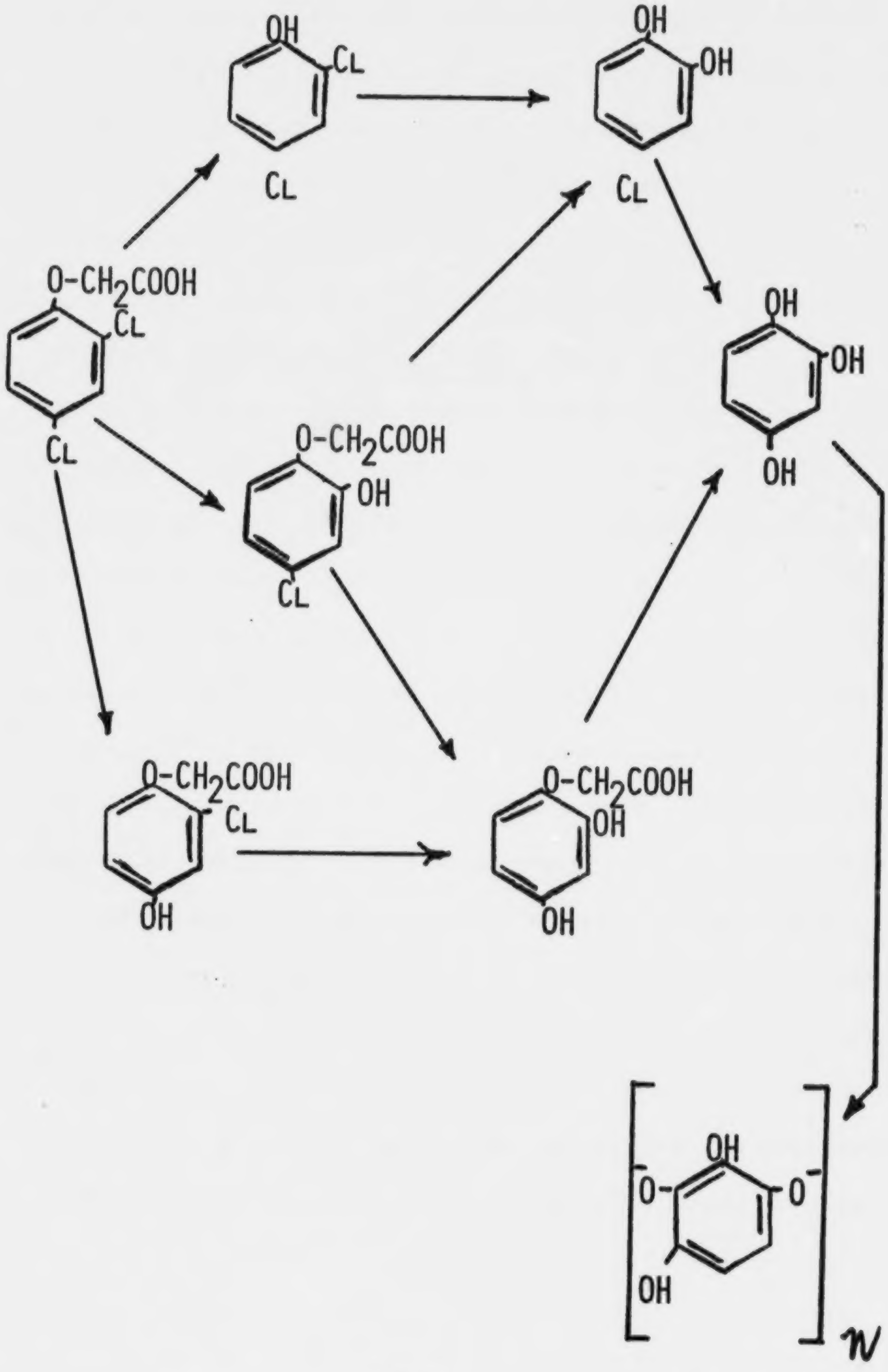
Herbicides undergo chemical and metabolic reactions similar to those of any chemical in living systems and not unlike those reactions observed with insecticides. Thus, oxidation, hydrolysis, dealkylation, conjugation and reduction are seen to occur. The rate at which chemical alterations occur depends upon the initial chemical, the particular living organism and the environmental circumstances under which each finds itself. (33)

A great variety of natural environmental factors can and do play important roles in the non-biological degradation of many pesticide compounds. The oxidation of several herbicides, including 2,4-D, can be effectively carried out by non-living forces. (33) Such non-biological degradation of 2,4-D is depicted in Figure 16a, and shows photolysis through a series of reactive intermediates with replacement of the chlorine by hydroxyl groups and ether bond cleavage. The resulting 1,2,4-benzene triol is non-photochemically oxidized to a polymeric humic acid, a non-toxic naturally occurring compound. Such a reaction, it is said, can occur within minutes on damp filter paper in sunlight. (33)

2,4-D can be metabolized to a limited extent by mammals and to a greater extent by plants and certain microorganisms. Some of the resulting identical pro-

FIGURE 16a

PHOTOLYTIC DEGRADATION OF 2,4-D (34)


OH
CL
CL
OH
OH
CL
O-CH2COOH
CL
CL
OH
OH
OH
O-CH2COOH
OH
CL
O-CH2COOH
CL
OH
O-CH2COOH
OH
OH
OH
O
O
OH
n

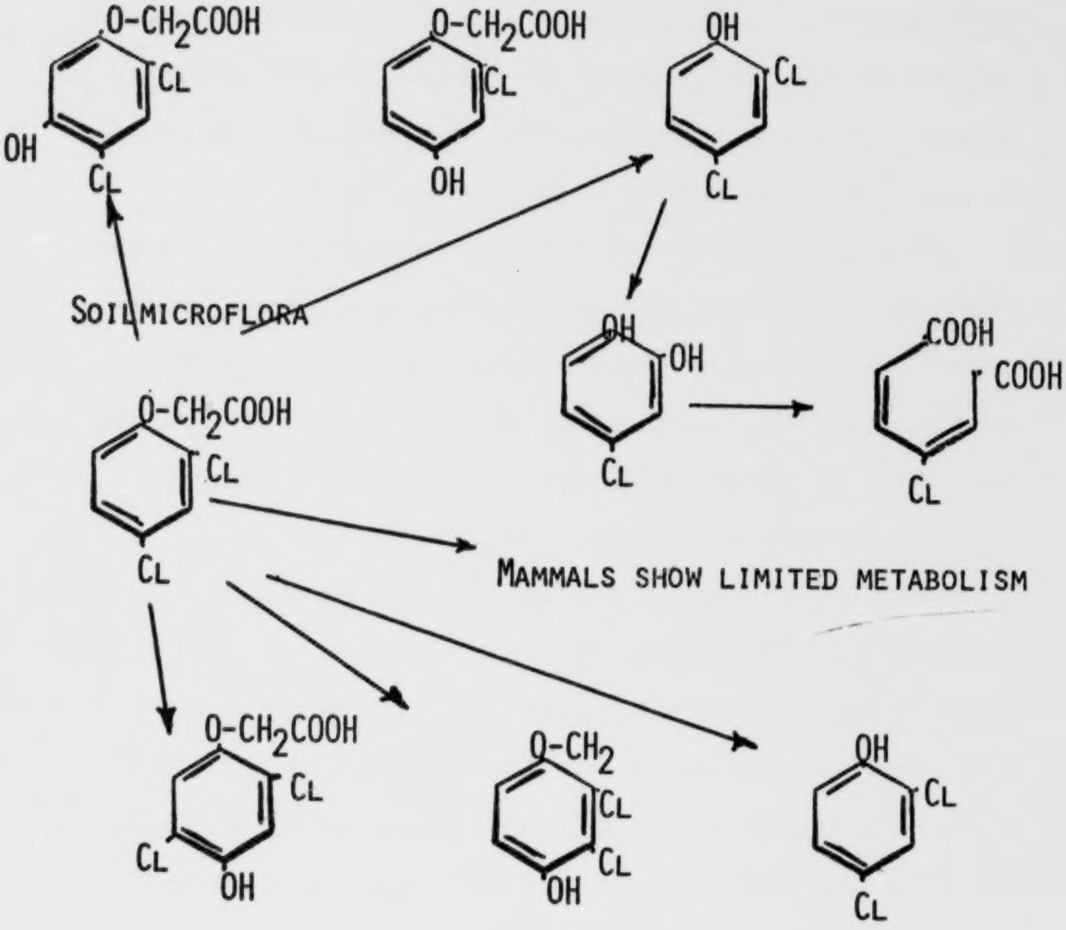
42-C

POLYMERIC

HUMIC ACID

FIGURE 16b

GENERAL METABOLISM OF 2,4-D IN PLANTS, MAMMALS AND SOIL MICROFLORA (34)


O-CH2COOH
CL
OH
CL
O-CH2COOH
CL
OH
OH
CL
CL
SOIL MICROFLORA
OH
OH
CL
COOH
COOH
CL
O-CH2COOH
CL
CL
MAMMALS SHOW LIMITED METABOLISM
O-CH2COOH
CL
CL
OH
O-CH2
CL
CL
OH
OH
CL
CL

CONJUGATION WITH: AMINO ACIDS, PEPTIDES, CARBOHYDRATES ducts are shown in Figure 16b. (34)

Not all apparent disappearance results in degradation or non-metabolic alterations. It has been shown that the common soil microorganism, Pseudomonas fluorescens, which does not metabolize 2,4-D as a sole carbon source, can remove the herbicide from solution rapidly by adsorption onto the cell surface, followed by passive diffusion into the cells. (35)

The conclusions reached by several authors suggest that the substituted triazines, while not being particularly detrimental to aquatic animals at usage doses, may persist for considerably longer times in submerged sediments and under anaerobic conditions generally, than in terrestrial soils. (36, 37)

Microbial degradation of side chains of atrazine occur much more rapidly than ring cleavage. Once chemical hydrolysis has been initiated to yield hydroxy-atrazine, ring cleavage can occur to a much greater extent by microbial means than in the parent atrazine ring. Under submerged conditions, hydroxy-atrazine ring cleavage is accomplished principally by aerobic and facultative aerobic organisms. Atrazine and hydroxy-atrazine do not appear to be degraded or metabolized by anaerobic microflora to any extent.

Differences in the rate of generation of different products again depends upon the nature of the soil, its pH, organic content, etc. The two major pathways are diagrammed in Figure 17 and show that the pathway of degradation most likely under anaerobic conditions would be dealkylation by faculative aerobes. The rates of dealkylation and ring cleavage would be quite slow.

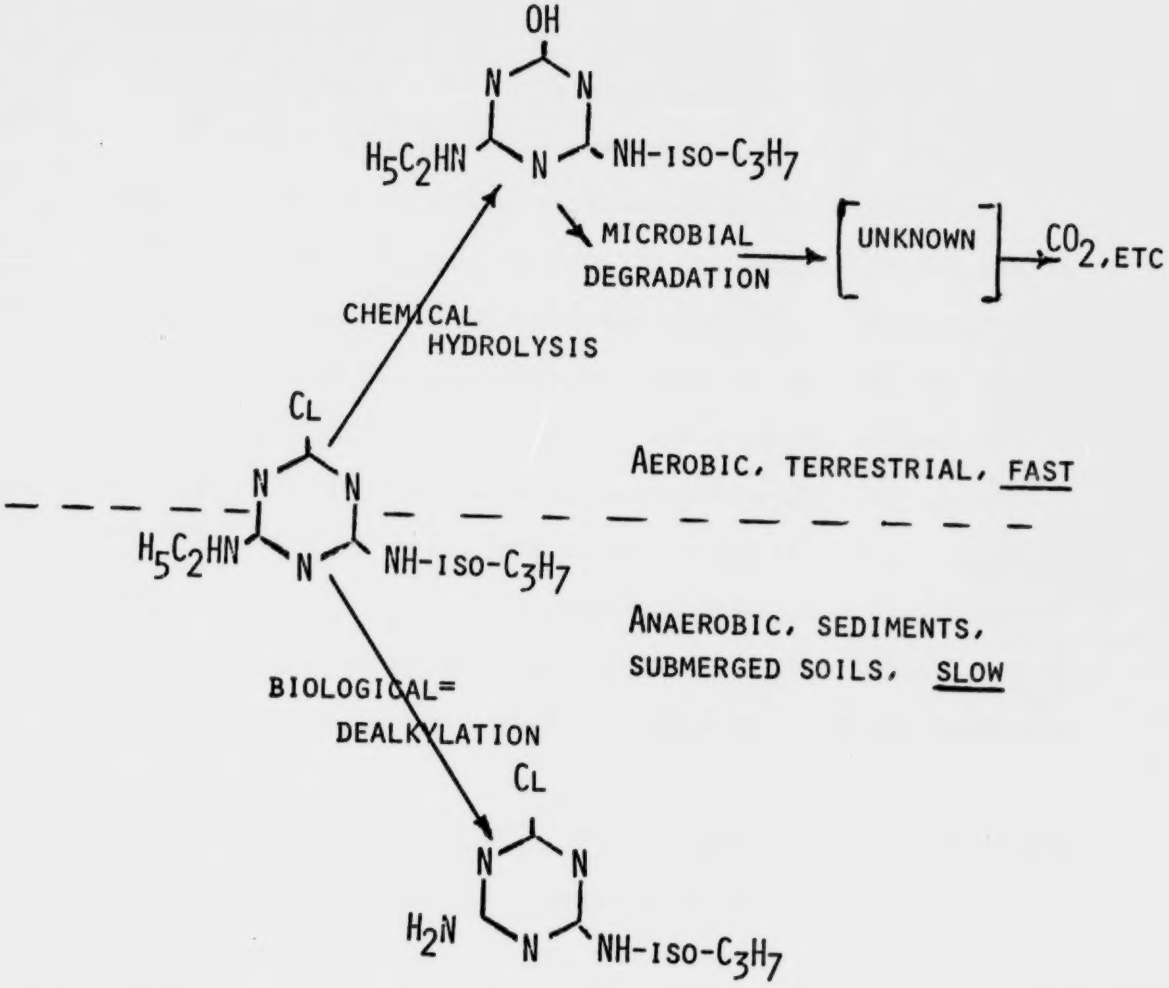
It has also been shown that atrazine hydrolysis is catalyzed by adsorption to soil or organic particles. (38) Hydrogen bonding between the ring or N containing side chains is thought to increase the electron deficiency of the carbon atom at the two positions of the parent molecule, already surrounded by electronegative N and Cl atoms, and thereby increase the rate of hydrolysis through attack by weakly nucleophilic H_2O. Lowered soil pH and higher organic matter have been identified as increasing the rate of hydrolysis by several authors. (36,37)

Quantitative Documentation of Persistence

It is difficult to attempt a strict separation of degradation from persistence *per se*. The rate of degradative processes under differing conditions in field and laboratory will obviously determine the level of remaining pesticide. We can draw from the published litera-

FIGURE 17

BIOLOGICAL AND CHEMICAL DEGRADATION OF ATRAZINE (37)


OH
N
N
H5C2HN
N
NH-iso-C3H7
MICROBIAL DEGRADATION
UNKNOWN
CO2, ETC
CHEMICAL HYDROLYSIS
CL
AEROBIC, TERRESTRIAL, FAST
ANAEROBIC, SEDIMENTS, SUBMERGED SOILS, SLOW
BIOLOGICAL= DEALKYLATION
H2N

ture, however, and establish some limits for persistence of various compounds.

Table 3-C seeks to summarize a fraction of the data available on persistence. In-depth studies show that for soil, the basic soil characteristics are most important in determining the rate of degradation. These characteristics will, of course, determine the kinds and amounts of organisms present. Water is just as variable, in its own way, as soil; here, the basic chemical and physical nature and the kinds and amounts of organisms present will determine degradative rates and persistence. Thus, two waters apparently alike in all considerations, but one having more colloidal clay than the other, could be expected to adsorb and hence apparently rapidly *remove* from the water greater quantities of certain pesticides than the other. The compound did not, therefore, persist in water for a very long time - its fate now relegated to effects of the sediment. Similarly, many pesticides have been found to adsorb strongly onto living algae cells - to a much greater extent than onto clays. (4) If they now passively diffuse into an algal cell body they again did not *persist* in water for any great period of time - but now can rapidly enter the food chain where their degradative fate will be determined by entirely new and different sets of forces.

TABLE 3-C

PERSISTENCE OF PESTICIDES

Compound	Soil	Water
DDT	100 ppm/39%, 17 yrs. considerable variation	100 ppb/100%, 8 wks.
Toxaphene	140 ppm 6 yrs 50 ppm 100 ppm/45%, 14 yrs.	--------
Endrin	25 ppm/50%, 12 yrs. 100 ppm/41%, 14 yrs.	10 ppb/100%, 8 wks.
Methoxychlor	-------	--------
Dicofol	-------	--------
Aldrin	100 ppm/40%, 14 yrs. 25 ppm/50%, 4 yrs. See Text.	100 ppb/20%, 8 wks.
Dieldrin	100 ppm 6-9 yrs. 100 ppm/31%, 15 yrs. 25 ppm/50%, 8 yrs.	10 ppb/100%, 8 wks.
Heptachlor	ea. 13 ppm/9 yrs. 100 ppm/16%, 14 yrs.	10 ppm/25%, 1 wk. 0%, 2 wks. All (?) converted to epoxide
Hepta/epoxide	--------	10 ppm/100%, 8 wks.
Lindane	100 ppm/10%, 14 yrs. 25 ppm/2 yrs.	10 ppb/100%, 8 wks.
Chlordane	25#/A/ 12 yrs. 100 ppm/60%, 14 yrs.	10 ppb/85%, 8 wks. 100% - 15% tech. probably to other products
Diazinon	9 d. 12 wks.	--------
Parathion		
Ethyl	3.2 ppm/90 d.	690 d. @ 20°C 10 ppb/ 5%, 4 wks. 175 d. @ 20°C
Methyl	3.2 ppm/30 d.	10 ppm/10%, 2 wks.
Paraoxon		320 d. @ 20°C, see text.
Malathion	3.2 ppm/8 d. - - /2 d.	10 ppb/10%, 2 wks.
Dimethoate	2 mos.	50% in 8 wks.
Carbaryl	- - - - - -	10 ppb/50%, 1 wk. 0%, 2 wks.
Dicamba	2 mos.	--------
Atrazine	1.5 ppm/17 mos. ea. 15% residue/yr.	--------
2,4-D	1-3 ppm/30 d. ± 3ppm/4-18 wks.	1000 ppm/10 ppm, 30 d. 10 ppm/6 wks.

In soil and in water, depending upon the inherent stability of the molecule, pesticides are subject to a variety of physical environmental forces; temperature, pH, and the kind and quality of light are probably the most important.

Eight major U. S. cities were examined for total DDT residues from urban soil. Generally, the soils were found to have heavy pesticide residues compared to cropland residues from the same states. Lawn or green areas had higher residues than waste or non-used portions. As might be expected, there was considerable variation found. All cities had different soil types and the absolute quantities of prior pesticide use were undetermined. (41) No similar study of suburban garden soils appears to have been made.

Examination of Table 3 suggests that the chlorinated hydrocarbons are the most persistent compounds, as we all know. The organophosphorus and carbamate compounds the least, under the widest possible range of conditions.

The artificiality of such a presentation should be obvious. Variations in soil or water conditions, climate, biological activity, etc. would have to be examined for each individual circumstance.

The persistence of other chlorinated hydrocarbons has been observed to follow DDT in a general way. (7)

The extremely heavy applications in one study (39) have probably masked the effect of total persistence and/or translocation. Thus, heptachlor (10 pounds per acre) rapidly disappeared from soil or was converted to the epoxide so that by the end of three years following application, less than 70 percent of the original was present as either the parent or epoxide. At the end of six years, no heptachlor was found at all and only 10 percent of the original application remained as the epoxide. The material was not translocated by plants and removed by cropping nor did it move downward into the soil.

Similar documentation with aldrin and dieldrin appears to suggest a like fate. (48) Study after study has clearly demonstrated that combined annual applications of these materials does not result in appreciable soil build-up. Indeed, the reverse is seen; with 85-90 percent loss of applied aldrin within one year a common feature. Dieldrin, the epoxide of aldrin, has been observed to persist for 5 to 25 years (average, 8) to degrade 95 percent of the applied dosages. Aldrin is known to be approximately thirty times as volatile as dieldrin. It would appear from all sources of information, that when aldrin is applied to soil, it moves upward through the soil with water to the soil surface and volatilizes into the air. This apparently happens so fast in lighter soils that very little of the applied dose has a chance to be altered to dieldrin before it is lost to the atmosphere and becomes a part of the total global contamination.

While fungal attack of DDT and its relatives has not been shown, the cyclodiene pesticides apparently are capable of considerable biological alteration by fungi. (17) Much more study is badly needed for this major group of soil and water degradative sources.

Technical chlordane is a mixture of two isomers of chlordane plus chlordene and heptachlor. The technical product should, therefore, show a variety of persistence responses. Thus, technical chlordane added to river water is seen to degrade to the two isomers and γchlordane within two weeks. These products are stable for at least eight weeks. Heptachlor apparently reaches an equilibrium between the epoxide and 1-hydroxy-chlordene. The epoxide is eminently stable; hydroxychlordene may be converted to chlordene under these conditions.

The degradation of chlordane as well as other organochloride in soil has been investigated. (7) Approximately 50 percent of the applied dose remained after 10 years. The soil, so treated, was maintained is such a manner that leaching, volatilization, photodecomposition, mechanical removal, and biological decomposition were minimized. Under these conditions, it was felt that the upper limit of persistence of these insecticides in soil was probably reached. This situation is rarely encountered and the conditions which would repeatedly bring new soil to the surface and expose the pesticide to volatilization, mechanical transport, or photoalteration (i.e., cultivation) are the more common conditions, both for agriculture in general or the home gardener in particular. It should be remembered that the soil type, clay content, organic matter content, pH, and biological activity all will determine the rates of decomposition and/or persistence. Application rates were so high in these experiments that the micro fauna was probably entirely eliminated, thereby eliminating the possibility of micro tillage and decomposition by soil animals. The possibility of degradation by bacterial or fungal populations was not examined and remains as a distinct possibility.

Lindane (γ-BHC) adsorption was affected by sediment suspension concentration, clay content, organic matter content and γ-BHC concentration in natural lake sediment studies. (42) Anaerobic degradation in lake sediments was much faster than aerobic degradation; the former degrading 90 percent of added dose in 2,100 hours incubation, and the latter only 15 percent during the same period. This dependency on oxygen, plus a decided lag phase in the reaction, has caused the author to conclude that degradation probably occurs by some biological mechanism. (43) Isomerism of the degradative products appears to reduce the toxicity of resulting compounds.

The hydrolytic degradation of parathion in these lake sediments occurs much faster than in sediment free aqueous systems. Hydrolysis is rapid in alkaline solutions as in other members of this group (t 1/2 3,250 hours at pH 7.0 and 138 hours at pH 10). Little difference in t 1/2 values is observed between sterile and non-sterile samples (258 vs. 220 hours) but at pH 5.3 of these samples, such hydrolysis may have been speeded by biologically generated enzyme systems.

The water used in one study, while adequate for that study, is, after all, just one sample (what about the rate of disappearance for water taken at other times of the year?) and would probably yield rather different results under other natural conditions and with other water samples. (43) One would, for example, like to see the same experiment conducted under natural conditions (the stream) where temperature and photoperiod would be more varied and natural - and with more kinds of water.

An interesting point was brought to light and verified to some extent by the studies which followed toxaphene application for fish eradication (44). In these studies, two lakes which differed greatly in their basic nutrient levels, and hence their biological productivity, were shown to degrade toxaphene at two vastly different rates. One, the more oligotrophic, was treated at 44 ppb, declined to 2 ppb and remained here for 5 years. The other, more shallow, and definitely more oligotrophic, had twice the initial application, declined to about the same level (2 ppb), but reached this level after only one year. Thus, the combined activities of warmer water, more intense biological activities and more rapid turnover and redistribution of bottom sediments, resulted in the applied toxaphene being distributed throughout the entire ecosystem - exposing the applied dose to more living material where it could be held for varying periods of time. It did not disappear, however, and showed considerable biomagnification potential. These factors are results of the species concerned and on the concentration of chemicals in the water, of course, and not dependent on the water itself to any great degree (excluding temperature).

A further point, potentially more interesting than the above, comes from the data of fishes exposed in live cars to contaminated lake water. Fishes exposed to 1-2 ppb could not survive this exposure for more than 10 days and accumulated toxaphene at a rate of approximately 1,200 ppb/day or 1,000 times the ambient concentration. When exposed to 0.84 ppb in water, the same species accumulated toxaphene at 666 ppb per day, or about 800 times the ambient until they had accumulated approximately 8 ppb or 1,000 times the ambient per day. Both sets of data resulted in accumulation roughly 10,000 times ambient for the period of measurements (10 days or 8 days). However, fishes exposed to two-thirds of the concentration demonstrated to be lethal (1.20 ppb) did not die and reached an equilibrium around 8 ppm. Thus, the degree of exposure and rate of accumulation are seen to be vitally important to an assessment of toxicity. It is said, as we have pointed out, that more data is not available on this point so that more valid comparisons can be made.

The commonly used organophosphorus and carbamate compounds are found to degrade rapidly in the soil and water systems. Some potentially harmful metabolites may be elaborated during hydrolysis. Most of these compounds are rather rapidly taken up from water by all kinds of living material, although at considerably different rates (see remarks in next appendix).

Dimethoate appears to have a much greater potential for persistence in water (only 50 percent in eight weeks) than other organophosphorus compounds examined except ethion. The persistence of ethion might be explained on the basis of stability conferred by steric hindrance due to molecular symmetry. Dimethoate is not symmetrical, however, and no explanation of its stability is offered. (43)

Carbaryl decomposed quite rapidly in raw river water (95 percent per one week) with the major metabolite, 1-napthol, apparently degrading as rapidly. Some authors have found that sea water degrades carbaryl (Sevin) at a rate of about 20 percent per day at 20°C and a pH of about 8. (45) Similar results have been obtained in raw river water (44) at approximately the same temperature and probably somewhat lower pH. In both cases, the conditions for hydrolysis are considerably lower than indicated by the manufacturer. The hydrolysis product, 1-napthol, was found to be of variable stability depending upon conditions (see next appendix).

Application of two pounds per acre of carbaryl to grain crop grassland resulted in residues of 39 ppm on plants the first day. Only 1 percent persisted to the sixteenth day (0.37 ppm). (46) The persistence of 2-isopropoxyphenyl N-methylcarbamate in raw river water (44) is considerably greater than carbaryl; measurable quantities observed up to eight weeks after application with only 50 percent degraded after the first week. It is suggested that possession of the isopropyl group is somewhat initially inhibitory. All carbamate compounds examined degraded completely by eight weeks in river water, but little is known about the true fate of their metabolites.

In summary, it has been seen that many of the commonly used persistent pesticides are degraded to one degree or another by a wide variety of organisms, including bacteria, fungii, certain higher plants, insects, and some vertebrates. The rate of metabolic alteration found depends upon the species, the conditions of the experiments, sex and a multiplicity of other physiological and environmental factors. The fate of the metabolites is almost completely unknown although, generally, they are less toxic than the parent compounds. In addition, a variety of completely chemical and physical alterations have been observed.

The organophosphorus and carbamate compounds, while initially more toxic than organochlorides, are subject to a great variety of chemical and biological attacks, as are many of the herbicides in common use. The fate of many of these degradative products is unknown as well.

The chief conclusion to be drawn from this situation is that our knowledge about the fate and degradation of pesticides in the environment is very small indeed. This is especially true of the home and garden area. The type of research required to fill these knowledge gaps is quite complex and, therefore, expensive and time consuming. It is unlikely that such an effort would be justified or supported for a chemical which is used only in the home and garden pesticide market. However, it is hoped that with the increasing general concern about these matters, research will soon be initiated to systematically resolve these questions, at least for the most important agricultural pesticides. The information to be obtained from such studies will be very useful in gaining a better understanding of the fate of home and garden pesticides, and in reducing or eliminating practices and products which may have a high environmental pollution potential.

The foregoing holds considerable hope that many pesticide formulations may degrade at much faster rates than previously known, indeed, it is encouraging to find that many degrade at all. These facts should not create the feeling that unrestricted use of pesticides is warranted, however, as we will see in the next section.

Recommendations

1. Encourage and support down-to-earth, interdisciplinary research on the fate and degradation of pesticides in the environment under field conditions.

2. Investigate and identify the major metabolites in several animal groups before final registration of new products. This should include at least one warm blooded (rat, mouse, rabbit, dog) and one cold blooded animal (suitable fish) and one or more common invertebrate species, at least one of which is an aquatic organism.
3. Investigate and identify the major metabolites in several plant groups before final registration is granted. For herbicides these should include several terrestrial non-target species. For both herbicides and pesticides, the metabolites of several aquatic species of filamentous algae as well as common diatoms and unicellular algae of the primary producer group should be identified.
4. Investigate and identify the nature of metabolites and extent of decomposition of new products by common soil and water microorganisms before final registration is granted.

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APPENDIX D

AQUATIC IMPACT

Decidedly different features characterize the urban-suburban contribution of pesticides to the water environment from those of agricultural use. The contractor's survey and analysis of use patterns indicates that roughly fifty percent of each type are used: organochlorides, with relatively low acute toxicity and long persistence, and carbamates and phosphates, with relatively high acute toxicity and much shorter persistence. This is in contrast to the results from a five state agricultural area (EPA No. 68-01-0117) where the use of organochlorides was more than fifty to seventy-five times the use of organophosphates and carbamates combined.

In keeping with the considerable diversity of compounds employed by homeowners and home gardeners, we have selected the most used compounds and will concentrate on them. Charts and/or tables attempting to summarize all of the considerable body of information available in some areas would become unnecessarily confusing. The contractor has, therefore, selected and combined material in order to give the broadest possible coverage and to demonstrate particular points. Liberal use has been made of numerous review articles, compilations, and textbooks in addition to valuable literature references. (1,2,3,4,5,6,7,8,9,10)

The Aquatic Ecosystem

A thorough understanding of trophic structure and trophic level dynamics is still wanting. An appreciation of the complexity of trying to understand the effects of a foreign chemical when applied to any natural, living system, when we are really only at the threshold of understanding of the system itself, should be obvious.

It would appear to be imperative that we begin to view the global implications of pesticide use more carefully. The agricultural use of pesticides to insure a continued high yield of high quality food and fiber is not at issue nor is the home and garden use to insure pleasant surroundings, thrifty flowers and shrubs or freedom from noxious pests. What is at issue is the kinds of products used, the quantities applied and an implementation of practices which will insure minimum damage to our fragile environment.

Although some studies have been conducted on basic physiological responses of fishes and pesticides, such studies are largely lacking from invertebrate animals.

The oyster and some few other commercially valuable species are exceptions. That these other animals are vital links in the chain of concentration of pesticides residue has been amply demonstrated. The point which should be made, perhaps, is that basic physiology -- especially as it relates to growth and population dynamics, may be the most important feature. The good health of any food chain or trophic structure rests on the good health and perpetuation of any individual trophic level. Thus, we believe that more fundamental experiments should be instituted to determine the long-range effects of sublethal exposure on basic invertebrate groups, especially as such exposure relates to intrinsic rates of natural increase. Unfortunately, we know relatively little about the basic physiology of these organisms, let alone their population dynamics.

Fundamental to our discussion and directly relevant to the different organochloride compounds, is the question of whether other compounds (i.e., cyclo-dienes) follow the picture of distribution observed in the much more widely examined family of DDT and its residues.

Of equal impact, we think, are the seasonal aspects of pesticide residues, accumulation and natural toxicity. Virtually no data is available to help identify how seasonally altered metabolism and basic physiology may equip an animal to cope with pesticide exposure.

Several additional points are made which deserve our attention. The suggestion is made that the concentration of pesticide in birds is in equilibrium between intake and excretion (and metabolism) of insecticide residues. Thus, if the rate of metabolism and excretion is greater in certain vertebrates than in invertebrates or food of the next trophic level, no concentration or biological amplification would be seen. One assumes that the reverse is true in some, but not all, food chains, since many examples are seen which indicate a progressive accumulation and concentration up the food chain or trophic level.

Clearly much additional research is necessary to identify the fate of parent compounds and residues at each trophic level. This is particularly true as it relates to the rate of turnover of the compounds.

A step in the right direction is seen in the recent work of Metcalf and co-workers (11). The model ecosystem they propose could be very useful in relatively rapid screening tests of large numbers of compounds as well as in identification of the fate and chemical nature of metabolites. We feel that the worth of such an approach could be improved tremendously if all levels were investigated (i.e., bacteria, fungus, protozoans, etc.).

Short-Term Effects

It is possible that an adequate distinction between acute and chronic effects of pesticides could create as much of a problem as the distinction between degradation and persistence. Levels which were just barely subacute under one set of circumstances might be extremely toxic under others. What is acute to one animal species may have little effect on another under one set of environmental conditions with the toxicity reversed under other conditions, etc. So complex does this become that valid comparisons between data are often impossible. Of particular interest is the fact that data collected by two different authors often conflicts so badly that comparison between what purports to be the same is likewise impossible.

A point source of highly toxic compounds, such as those generated by heavy residential use, even though they degrade quite rapidly in soil or water, could, under appropriate conditions, constitute a serious health hazard for aquatic life. It should also be noted in passing that if damage to the aquatic environment could be demonstrated either by outright death or reduced population of organisms, the suspect material, if it was a rapidly degradable compound, would, in most cases, be degraded before adequate identification could be completed. The same is not true, of course, for the more persistent organochlorides. Of particular impact here is the fact that the same point source, whether it be sewage outfall or storm water drainage, could, through its heavy load of acutely toxic compounds, so weaken or debilitate aquatic organisms that lower levels of organochlorides would now become more lethal through the combined or synergistic effects of both. Such a problem does not appear to exist in areas of intensive row crop cultivation generally.

It has been demonstrated that peak rainfall and time of application,coinciding as they do over much of the country, presents a particularly threatening situation during the spring and early summer. It should be remembered that this is the time of year of maximum growth and food conversion for fishes as well as the period of most active reproduction, incubation, and development of young.

Examination of population densities and river discharge patterns suggests that East Coast estuaries stand to suffer the greatest potential harm during the months of April, May, June, and July when the greatest amount of soil is disturbed and application of pesticides is the greatest. The impact of suburban and urban use here is contrasted to the interior drainage of the Mississippi Valley and associated drainages, where lesser populations in suburban areas add to the already heavy load of agricultural chemicals. These combined contributions pose a more serious threat to fresh waters of the interior of this basin than to the Gulf coastal estuaries, the more toxic compounds generally having been degraded during their time of travel to coastal estuarine waters.

Certain portions of central and southern California estuarine areas have a high potential for harm through the combined actions of heavy residential use of toxic compounds, heavy, intensive agricultural use of both toxic and less toxic compounds and the outfall from manufacture and formulation of highly persistent but less toxic chemicals.

Short-term effects, then, could be noted in the outright death of aquatic organisms in some local static situations. The effects of pesticide translocation resulting from heavy rainfall would probably have little effect on the aquatic environment due to the considerable dilution involved.

Examination of Table 1 indicates that considerable variation in response is possible. Two species; trout and sunfish, were chosen because they are supposed to represent extremes of environmental requirements. In a very

TABLE 1

RESPONSE OF TWO FISH SPECIES TO PESTICIDES AS MEASURED BY LC_{50} (Various Sources)

Heptachlor	BG	$^{96}LC_{50}$	0.019 ppm
	RBT	$^{48}LC_{50}$	0.009 ppm
	RBT	$^{24}LC_{50}$	0.015 ppm
DDT	RBT	$^{48}LC_{50}$	7.3 ppm
	RBT	$^{96}LC_{50}$	0.007 ppm
	BG	$^{96}LC_{50}$	0.008 ppm
Chlordane	BG	$^{24}LC_{50}$	0.010 ppm
	RBT	$^{24}LC_{50}$	0.022 ppm
	RBT	$^{48}LC_{50}$	0.010 ppm
Dieldrin	BG	$^{48}LC_{50}$	0.0034 ppm
	BG	$^{24}LC_{50}$	0.0055 ppm
	RBT	$^{24}LC_{50}$	0.019 ppm
Lindane	RBT	$^{24}LC_{50}$	0.030 ppm
	RBT	$^{48}LC_{50}$	0.018 ppm
	BG	$^{24}LC_{50}$	0.100 ppm
	BG	$^{48}LC_{50}$	0.076 ppm
Dicofol	RBT	$^{48}LC_{50}$	100 ppm
Toxaphene	RBT	$^{24}LC_{50}$	0.05 ppm
	RBT	$^{48}LC_{50}$	0.0028 ppm
	BG	$^{96}LC_{50}$	0.018 ppm
Aldrin	RBT	$^{24}LC_{50}$	0.036 ppm
	RBT	$^{48}LC_{50}$	0.003 ppm
	BG	$^{24}LC_{50}$	0.096 ppm
	BG	$^{48}LC_{50}$	0.0083 ppm
Endrin	BG	$^{48}LC_{50}$	0.7 ppm
	RBT	$^{48}LC_{50}$	1.2 ppm
Parathion	RBT	$^{48}LC_{50}$	2 ppm
	BG	$^{48}LC_{50}$	0.047 ppm
Methyl Parathion	RBT	$^{96}LC_{50}$	2.75 ppm
	BG	$^{96}LC_{50}$	8.72 ppm
Malathion	RBT	$^{24}LC_{50}$	0.130 ppm
	RBT	$^{96}LC_{50}$	0.170 ppm
	BG	$^{24}LC_{50}$	0.140 ppm
	BG	$^{96}LC_{50}$	0.103 ppm
Dimethoate	BG	$^{48}LC_{50}$	9.6 ppm
	BG	$^{24}LC_{50}$	28 ppm
	RBT	$^{24}LC_{50}$	19 ppm
Diazinon	BG	$^{24}LC_{50}$	0.052 ppm
	BG	$^{48}LC_{50}$	0.030 ppm
	RBT	$^{24}LC_{50}$	0.380 ppm
Carbaryl	BG	$^{96}LC_{50}$	6.76 ppm
	RBT	$^{96}LC_{50}$	4.38 ppm
2,4-D (Butyl Ester)	RBT	$^{48}LC_{50}$	1.1 ppm
	BG	$^{48}LC_{50}$	1.3 ppm
Dicamba	BG	$^{48}LC_{50}$	130 ppm
	RBT	$^{48}LC_{50}$	35 ppm
Atrazine	RBT	$^{48}LC_{50}$	12.6 ppm
	BG	$^{96}LC_{50}$	10 ppm

real sense they do; their responses to temperature and dissolved oxygen often being cited. In truth, many of the physiological factors which determine whether or not one fish species will have a high oxygen requirement, or require lower or higher ambient temperature, have not yet been determined. We can identify some of the obvious differences - we do not know the reasons behind the differences. The artificiality of such lists is further exemplified by examination of the species composition of animal forms making up any particular environment. For example, bluegill, a typical warm water fish form, is often found in combination with other fish species which are considerably less tolerant to levels of certain pesticides which may have been found harmless to the bluegill. It would not be surprising to find fishes which would be even less tolerant under their environmental conditions than would be the trout under its typical environmental conditions. It can be seen that the two fishes chosen do show considerable differences in their responses to pesticides; lethal concentrations which yield 24.48 or 96 hours LC_{50} for organophosphates, carbamates, or the listed herbicides will probably never be found as the result of home and garden use of pesticides. Such concentrations will undoubtedly be reached in certain local conditions (golf course or country club ponds, city park ponds, etc.) as a result of careless application of pesticides for vector control. These situations are not particularly important to the overall use of pesticides since the calculated rates of degradation and metabolism should insure that the applied doses, no matter how carelessly used, would not build up or persist for any period of time.

All pesticides appear to be accumulated (whether absorbed or adsorbed) onto and into living material at extremely rapid rates. What portion actually is physiologically potent to the organism is open to question. Thus, numerous authors have demonstrated concentration of pesticides by algae and bacteria of 500 to 1000 times within hours of application (12,13,14,15). Low concentration (1 ppm) appears to allow greater accumulation - apparently having little identifiable effect on the organisms. (16) Higher concentrations (100 ppm), while they apparently do not kill algae cells, do reduce photosynthesis effectively (17). Since growth (new cells) in algae is dependent upon photosynthetic activity and the accumulation of certain levels of food reserves, it is important that we understand effects of pesticides on these organisms. It can be seen that it is important to identify how an experiment is conducted before attempting a statement of effects. Thus, while one author shows no effect on respiration at one level of pesticide exposure, another shows reduced photosynthesis at the same or an even lowered level of exposure. At present, reduced carbon fixation has been observed in many marine and freshwater diatoms, filamentous algae and others including desmids and blue-green algae.

Algae and other photosynthesizing plants as well as fungi and bacteria probably acquire pesticides by absorption across limiting membranes; the relative insolubility in water and the high solubility in lipids creating an apparently "active" accumulation. Whether active transport or passive diffusion is involved is still open to question. In any event, many algal forms are observed to concentrate pesticides to quantities far in excess of that of surrounding water. Data from field studies suggests concentrations over one thousand times water are possible. Controlled laboratory studies have demonstrated concentrating abilities of 120-270 times the medium in seven days for 2 species of Blue-green algae, 1 Desmid, 1 filamentous species, (16) while other studies with natural populations have demonstrated that benthic algal species can concentrate at least forty times the water concentration. Observations in Scottish streams following the dumping of sheep dip have indicated that diatoms of the aüfwuch^s can concentrate dieldrin to over

1200 times that of water in less than one day. (13) Several species of aerobic floc forming bacteria were observed to absorb aldrin from solutions and concentrate 625 times the media in 20 minutes.

Thus, Protozoan species, especially those which feed on bacteria, can ingest considerable quantities of pesticide in very short periods. Diffusion through or across the general body surface as well as pinocytotic activity are other active routes of uptake.

Low concentrations of DDT (10 mg/70 ml) apparently do not inhibit growth of Euglena, but caution is emphasized here since it was found that the suspending medium, ethanol, was responsible for growth anomalies observed.

Chlorella and Euglena were observed to adsorb and absorb 60 to 80 percent of the quantity of lindane present in aqueous solutions. Concentration in the food chain at this level is specifically indicated but hydrolysis and microbiological degradation is not ruled out.

The results observed are not consistent within plant toxonomic groups, however, and no generalization can be made other than there seems to be an effect on photosynthesis. Although quantities of many pesticides in water (especially chlorinated hydrocarbons) are rarely over the parts per billion range, the propensity of these forms to adsorb high levels of pesticides rapidly and then affect absorption by simple diffusion and accumulate concentrations in the parts per million range is sufficient to suggest that many pesticides, at levels currently monitored, could reduce photosynthesis under appropriate circumstances.

The fantastic ability of many zooplankters and benthic forms to accumulate pesticides from very dilute solutions is well known. To accomplish biomagnification, the organism must survive initial exposure. Table 2 lists some typical ranges of responses to acute exposure to pesticides. Application of "safe use" levels for the least resistant forms will probably confer some degree of safety on other organisms of the same group. A wide range of response is seen, however, and all aquatic forms are considerably more susceptible to exposure than terrestrial forms.

It would appear that, except for local situations of extremely heavy application or accident, there is little likelihood of acute damage to aquatic forms resulting from the normal use of home and garden formulations under inland conditions. Carelessness, intentional dumping, or flagrant violation of manufacturers' specific directions could certainly result in local damage from any of the formulations. The potential for damage appears to be greater with some of the organophosphorus or

TABLE 2-D

RESPONSE OF AQUATIC INVERTEBRATES TO PESTICIDE EXPOSURE

DDT	$^{24}LC_{50}$- Anthropods (including aquatic insect larvae) 0.003 ppm to 0.041 ppm. $^{48}LC_{50}$- do - 0.00036 to 0.019 ppm. $^{48}LC_{50}$- crayfish - 0.6ppm Stream insects 0.5-1.0 lb/A - serious population alterations, mortality (see text).
Heptachlor	$^{48}LC_{50}$- Aquatic anthropods - 0.006-0.10 ppm $^{48}LC_{50}$- do - 6 to 50 ppm.
Lindane	$^{48}LC_{50}$- Waterfleas 0.460 to 0.520 ppm $^{48}LC_{50}$- Other aquatic anthropods 0.008 to 0.460 ppm
Chlordane	$^{48}LC_{50}$- Aquatic anthropods 0.020 to 0.080 ppm $^{48}LC_{50}$- Waterflea 0.020 to 0.029
Toxaphene	$^{48}LC_{50}$- waterflea 0.015 to 0.019 ppm. $^{48}LC_{50}$- aquatic anthropods 0.007 to 0.07 ppm.
Dieldrin	$^{48}LC_{50}$- Aquatic anthropods 0.0013 to 1.0 ppm. $^{48}LC_{50}$- Waterflea ea., 0.240 ppm.
Endrin	$^{48}LC_{50}$- Aquatic anthropods 0.00096 to 0.027 ppm. $^{48}LC_{50}$- Waterflea 0.020 ppm $^{48}LC_{50}$- Crawfish 0.3 ppm.
Parathion Methyl	F.W. mussels survived 0.12 ppm 4 hrs. $^{48}LC_{50}$- Aquatic anthropods 0.006 to 0.04 ppm $^{48}LC_{50}$- Waterflea 0.0004 to 0.0048 ppm.
Malathion	$^{48}LC_{50}$- Aquatic anthropods 0.002 to 20.0 ppm. $^{48}LC_{50}$- Waterflea 0.0018 ppm.
Dimethoate	$^{48}LC_{50}$- Aquatic anthropods 0.140 to 1.0 ppm.
Diazinon	$^{48}LC_{50}$- Aquatic anthropods 0.060 to 0.500 ppm. $^{48}LC_{50}$- Waterflea 0.0009 ppm.
Carbaryl	$^{48}LC_{50}$- Aquatic anthropods 0.0013 to 3.0 ppm. $^{48}LC_{50}$- Waterflea 0.006 to 0.008 ppm. $^{48}EC_{50}$- Various mussels 2.0 to 3.0 ppm.
Dicamba	$^{24}LC_{50}$- Amphipod 10,000 ppb.
2,4-D	$^{48}EC_{50}$- Brown Shrimp 2.0 ppm - 10% mortality or paralysis 1-4 ppm - reduced populations of common aquatic insect larvae 50% after 1 week. 1 ppb - apparently no effect (see text).
Atrazine	0.5 - 2.0 ppm reduced pond clam population over 85%. 1.0 ppm 96 hrs. no effect on growth of oyster. $^{48}LC_{50}$- Waterflea/3,600 ppb. 0.5 to 2.0 ppm reduced common benthic organisms 50%. 1.0 ppm/48 hrs. Brown Shrimp 30% mortality Considerable synergism suggested between atrazine and other herbicides against test beam plants. What effect these combinations may have on algae or other aquatic plants in unknown.

carbamate compounds initially - the fact that they degrade rather rapidly in the environment is hopeful.

It is entirely possible that coastal cities during periods of peak residential use of pesticides could, through their combined contributions, have an immediate and direct harmful effect on estuarine animals. Thus, it has been shown that quantities of insecticides designed to eliminate, but were not sufficient to kill pestiferous estuarine insects, were in fact sufficient to kill eggs and larvae of bivalves, reduce photosynthetic activity, and immobilize fishes. The ranges of toxicity to organochlorine insecticides was compared to that of fresh water forms and was distinctly greater in toxicity than other agricultural or industrial wastes or the organophosphorus compounds. Marine crustaceans generally were found to be much more sensitive to organophosphorus compounds than marine fishes. It has been further suggested that marine molluscs may be particularly susceptible to exposure as demonstrated by a reduction in reproductive potential following a sublethal exposure. (18) The fact that many of these forms are found to be more resistant than many marine teleosts or crustaceans is reduced by the fact that the number of eggs produced was severely reduced by some organochlorine compounds. Endrin and dieldrin were particularly more potent than lindane or DDT. (19) Young juvenile crabs were found to be much more sensitive to carbaryl than juveniles or adults and delayed expression was evidenced here as with other forms. (20) Of particular impact is the fact that crabs have been noticed to suffer harmful effects after feeding on clams previously paralyzed by pesticide exposure.

The hydrolysis produce of carbaryl, 1-napthol, was found to be less toxic than the parent compound to crustaceans, but more toxic to molluscs and fishes. (21)

Organophosphorus compounds, with the exception of dioxathion, were consistently less toxic to marine teleosts than organochlorides under standard conditions of salinity, temperature and pH (Table 3-D). (22) Eisler states that the toxicity to these fishes is intermediate between the highly susceptible marine decopod crustaceans and relatively resistant marine molluscs, and recommends that all future studies on marine organisms examine the effects on at least one animal from each of the distinct taxonomic groups. The contractor heartily concurs. Many factors affect the determined LC_{50} values. These include temperature, salinity, pH, degradation rate of compound, and toxicity of any possible metabolites. These were found to yield distinctly different results with one species (Mummichog) where organophosphorus com-

TABLE 3-D

SUMMARY OF LC50(96h) VALUES OF SEVEN ORGANOCHLORINE AND FIVE ORGANOPHOSPHORUS INSECTICIDES VERSUS SEVEN SPECIES OF ESTUARINE FISHES AT 24°/oo SALINITY, 20°C., AND pH 8.0 (22)

Insecticide	Atlantic Silverside	Bluehead	Striped Killifish	American Eel	Mummichog	Northern Puffer
Organochlorine:						
endrin	0.05	0.1	0.3	0.6	1.0	3.1
p,p'-DDT	0.4	7	1	4	5	89
heptachlor	3	0.8	32	10	50	188
dieldrin	5	6	4	0.9	10.5	34
lindane	9	14	28	56	60	35
aldrin	13	12	17	5	8	36
methoxychlor	33	13	30	12	46	150
Organophosphorus:						
dioxathion	6	35	15	6	20	75
malathion	125	37	250	82	240	3,250
Phosdrin	320	74	75	65	300	800
DDVP	1,250	1,440	2,300	1,800	2,680	2,250
methyl parathion	5,700	12,300	13,800	16,900	58,000	75,800

pounds showed increased mortality as temperature increased from 10°C-30°C and also with increase in salinity from 12 °/oo to 36 °/oo. Organochlorine insecticides, on the other hand, showed the greatest toxicity at intermediate temperatures and lowest at intermediate pH. (22) The important point here is that this kind of valuable experimentation is largely lacking from toxicity studies. Without an assessment of these environmental parameters, the usual toxicity studies fail to be of much practical value.

Differences in methodology, choice of test species, season of collection and maintenance, period of acclimation and conditions under which conducted, as well as diversity of response observed between species, all are sufficiently great to preclude strict comparisons between data (22).

Some points considered valuable, largely from the literature (23), are included in summary.

1. It has been pointed out that samples of standard insecticides can vary by as much as 10 to 100 times in their toxicity - even from the same source.
2. Results of acute toxicity should take into account the effects of latent sublethal effects. It has been recommended that evaluation should

be for a period of 13 to 20 days (LC_{50}, 96 plus 240 hours recovery time to 10 days continuous plus 10 days recovery). The post exposure mortality for some marine fishes has been found to vary considerably with the pesticide used and the conditions employed.

3. Certainly temperature and pH should be included in all studies as minimal environmental variations for all freshwater studies. Salinity must be included for marine and estuarine studies.
4. The practice of reporting the same data two different ways in the same paper (or review) is to be deplored. For example, 48 hours EC_{50} for the waterflea (species) reported 20 ppb and one paragraph later the 48 hours LC_{50} for waterflea at 0.020 ppm when the EC_{50} (immobilization) is the end point for the determination of the LC_{50}. Such a practice adds unnecessary confusion to an already difficult situation.
5. Federally sponsored research should stress obtaining maximum yield of information for money expended. Thus, once a person or group has gone to the trouble of reviewing 96 or 240 hours

assays, the work has just begun. It is imperative that after the hard, hand work of setting up these assays has been done that additional information be routinely gathered. Enzyme levels, tissue burdens, pathologies, etc. are suggested. Performance data (i.e., work, etc.) also suggested as being desirable to totally assess the effects of exposure.

Long-Term Effects

Chronic exposure to low levels (sublethal) of organochlorides has been shown to reduce photosynthesis in both marine and fresh water algal species. Several bacterial species have developed an induced resistance to these compounds. No definitive studies have been conducted to demonstrate the long-term effects of pesticides on phytoplankton or periphyton species or community structure and/or metabolism. It appears that no long-term, low level exposure studies have been conducted in laboratories, either.

Aquatic crustacea, a major contributor to zooplankton, are generally more resistant to organochlorides than to organophosphate or carbamates. A notable exception is their extreme sensitivity to DDT. Fishes, on the other hand, are generally less susceptible to organophosphates and carbamates than to organochlorides. A significant point is the fact that many of the common zooplanktons are capable of accumulating quantities of organochlorides several thousand times the concentration in ambient water within one day.

Aquatic insect larvae, another important component of aquatic food chains, are observed to exhibit a wide variety of responses, with the more fastidious species being generally more susceptible to intoxication than the less demanding species. All forms examined so far are capable of considerable degrees of bio-magnification. To date, an insufficient number of different groups have been examined to make a really valid statement.

Fishes have been the most widely examined group of aquatic animals due to their economic importance and their position as upper trophic level consumers. Studies have identified an alarming array of responses to long-term, low level exposure. Among these are, behavioral alteration disturbances, especially nitrogen metabolism; endocrine imbalance, particularly in regard to osmoregulatory failure and, mineral imbalance and reproductive failure due to steroid hormone disturbance.

Common to both fishes and other lower trophic level animals, has been the reduction of growth rate generally, as a result of altered food conversion; altered reproductive potential, both in terms of number of eggs produced as well as survival of young.

A feature common to all aquatic organisms would appear to be reduced fitness and increased susceptibility to disease, capture or the effect of parasitic infection as a result of long-term, low level exposure.

The above heading should probably read, relatively longer term effects - for there is a fine line between acute and chronic exposure.

It has been demonstrated that on a weight basis, many elements of lower trophic levels, primary producer groups, and second level or primary consumer groups, have the ability to concentrate pesticides at a higher rate than higher trophic levels. This point is vitally important since exposure, even for a very brief period, will result in some portion of the pesticide load being incorporated into the food chain immediately. The remaining, often larger, portion is bound, at least for a time, to inorganic and organic particles. Release from these sources into the food chain follows at a slower rate.

Astounding magnifications have occurred in only three days. Authors have stressed the impact of such magnification on succeeding trophic levels; 1) rapid accumulation during periods of limited pollution exposure 2) ability to concentrate even at extremely low ambient levels, 3) source of biological magnification of degradation products. Thus, the conversion of aldrin to dieldrin was 25% accomplished in three days and the degradation of DDT to DDE was 85% accomplished in the Mayfly nymph in three days. Additional metabolites were recovered from other organisms.

Cladocera (waterflea) subjected to less than one-fourth the concentration of aldrin as DDT, showed a two-fold biological magnification in one day for a rate of accumulation over eight times as fast as DDT. Similarly, Chironomus sp. and Hexagenia concentrated aldrin about four times faster than DDT in one day. The total biological magnification of Hexagenia bilineata was approximately equal for aldrin and DDT over the three-day period, but was only one-half the total magnification for aldrin in three days. This later fact may reflect the suspicion that equilibrium storage capacity was being reached, or that once a compound has entered the body, a differential storage is possible. It should be noted that dipterous larvae and Cladocera are two of the primary foods of young fish, in addition to being the two greatest concentrations observed. In any event, magnifications of 5,000 to 140,000 time in three days is sufficient cause for concern. See Table 4-D.

Until we know more about the ultimate fate of metabolic degradative compounds, little will be known about the impact of these compounds on aquatic organisms. We do know that complete degradation into totally harmless compounds usually follows rapidly after primary metabolic attack in the case of organophosphates and carbamates.

TABLE 4-D

REPRESENTATIVE BIOLOGICAL CONCENTRATION OF PESTICIDES BY LIVING ORGANISMS

Compound	Organism	Effective Concentration	Concentration Factor
DDT	Extremely Variable		
	E. Oyster	0.1 ppb/40 d.	70,000
	Clear Lake, California:		
	Plankton		265x
	Small Fish		500x
	Predaceous Birds & Fish		80,000-85,000x
Toxaphene	Deep Lake		
	Aquatic Plants	2 ppb	8,500x
	Invertebrates	2 ppb	2,500x
	Shallow Lake		
	Plants		500x
	Invertebrates		1,500x
	Trout		15,000x
	E. Oyster	0.05 ppm/10 d.	2,920x
	Big Bear Lake, Calif.:	0.1 to 0.2 ppm	
	Plants		---
	Zooplankton		10x
	Fish		100x
	Bird Fat		8,500x
Dieldrin	Rainbow Trout	.002 ppm	3,300x
	E. Oyster	0.001 ppm	1,000x
	Freshwater Algae	1 ppm/7 d.	150x
	Brown Trout		
	Gill	.0069 ppm/1-7d.	3,000x
	Muscle	.0069 ppm/1-7d.	300x
	Caddis Fly	.0069 ppm/1-7d.	3,000x
	Freshwater Mussel	2 ppb	500x
Lindane	E. Oyster	0.05 ppm/10 d.	60x
	Fish 50% lost in 2 d.		
	Brown Trout		
	Gill	.0008 ppm/1-7d.	5,000x
	Muscle	.0008 ppm/1-7d.	2,000x
	Caddis Fly	.0008 ppm/1-7d.	1,500x
Aldrin	Algae	1 ppm/7 d.	150x
	Bacteria (absorption)		
	20 minutes		625x
Heptachlor	E. Oyster	0.01 ppm/10 d.	17,600x
	Bluegill	0.05 ppm	315x
Endrin	Fathead Minnow	0.015 ppb	10,000x
	E. Oyster	0.001 ppm/10 d.	1,000x
	Algae	1 ppm/7 d.	170x
Chlordane	E. Oyster	0.01 ppm/10 d.	7,300x
	Freshwater Mussel	3.4 ppb	2,000x
Parathion	Fundulus	0.12 ppm, 4 hrs.	80x
	Mussel	0.12 ppm, 4 hrs.	50x
Malathion	Fish		
	50% applied lost in 1 day		
Dimethoate	---	------	---
Diazinon	Fundulus (50% lost 1 wk.)	0.32 ppm	10x
	Freshwater Mussel	0.32 ppm	2x
Carbaryl	---	-----	---
2,4-D	Fish	1 ppb	150x
	Mussel	1 ppb	380-700x
Dicamba	---	-----	---
Atrazine	---	-----	---

Many herbicides show intermediate persistence; addition of these compounds to public waterways could seriously reduce growth and photosynthetic activity in aquatic plants. Many cases are on record where heavy applications of herbicides caused heavy "die-off" of aquatic plants, with subsequent high oxygen demand generated by the mass decomposition. Such a situation has been previously described as being potentially harmful to aquatic animals in that the lowered oxygen content weakens animals and makes them more susceptible to pesticide effects in lower concentrations. It is doubtful whether the suburban contribution of herbicides will ever be responsible for mass "die-offs" but low level, chronic exposure could easily reduce plant growth and vitality, thereby seriously impeding one of our natural purification systems.

The annual application of organochloride compounds (30-60 million pounds) by home gardeners, home pest control applicators and municipal authorities, although it is less than the agricultural use of these compounds, nevertheless makes a considerable contribution to potential environmental contamination.

Toxaphene, in addition to being a potent direct pesticide, can be accumulated by some aquatic food chain organisms to quantities capable of causing toxic responses to fish when allowed to feed. Both Daphnia and mixed periphyton communities were able to accumulate sufficient toxaphene to kill test fishes. That accumulated by the periphyton killed all within 24 hours after the community had been subjected to repeated, sublethal, doses (0.01 ppm) for 336 hours and Daphnia subjected to 0.01-0.02 for 120-312 hours, caused some mortality. Insect larvae and planktonic algae did not accumulate enough toxaphene to be lethal to test fishes. (24)

It is suggested that single, sublethal exposures to food organisms, were insufficient to cause death, while chronic sublethal exposure probably kept up with or exceeded detoxification and hence allowed sufficient accumulation to occur in the case of Daphnia and periphyton. (25)

Heptachlor applied at varying rates (high to low) appeared in fish flesh very rapidly after application and reached its maximum concentration between three days to seven days. A precipitous decline of the parent molecule is observed following one week's exposure to fifty-six days, when virtually none could be found. The generation of heptachlor epoxide and related compounds (hydrolysis or metabolites?) is maximal from one to two weeks following application. A graphic plot of the data for two different ponds suggests that much of the heptachlor was probably quickly adsorbed and absorbed by other elements of the ecosystem becoming available to fish after the initial high loading of heptachlor. (26)

Chronic exposure to malathion by warm water fishes and aquatic invertebrates in one study demonstrated that losses of fish could not be correlated with treatment of 0.002 ppm or 0.02 ppm when treated biweekly. Fishes grew well and reproduced. Aquatic insect larvae, initially unaffected, showed serious reductions in numbers after the third and fourth treatment at the high exposure level. It was calculated that normal field application rates could create concentrations which could severely reduce aquatic invertebrates and possibly kill fish. The pH of the ponds was high enough (8.5) to permit rather rapid degradation of the applied chemical. (27) While 20 ppb (.02 ppm) had no effect on bluegill in the above studies, 40 to 80 ppb were directly lethal to bluegill in another study (28) which employed flowing water under laboratory conditions. Fishes held in 20 ppb resulted in death to males which suggests that the 20 ppb applied in outdoor ponds (27) was probably never realized as an effective dose level for bluegill under those conditions. Small deformations occurring in 10 ppb were sufficient cause to judge this concentration unsafe under these conditions. Therefore, concentrations calculated to be safe fell between 3.6 ppb and 7.4 ppb of malathion. All concentrations, including those considered safe, depressed brain acetylcholinesterase activity.

Several additional points concerning malathion are in order. The extreme variability observed within the same vertebrate class, i.e., fishes, creates an inherent problem with classification of cold water fishes and warm water fishes. Although such a scheme would appear to delineate two ecologically different and distinct sets of environmental quality, it does not, however, prove to be particularly valuable in establishing use levels of particular pesticides. For example, although trout and salmon are generally much more susceptible to malathion than many warm water fishes (0.1-0.2

ppm LC_{50}) as compared to 6.0-12.0 ppm) Table 5, it is seen that sunfish, perch and bass are affected by approximately the same levels (0.103-0.285 ppm) as the trout. The fact that the waters normally inhabited by these fish is subject to more varied extremes in temperature, both seasonally and daily, would appear to mitigate against the same criteria for toxicity being applied to both. Species of catfish, carp and minnows are found to be 30-50 times more resistant to malathion as their other warm water associates (bass, perch and sunfish).

Another feature which emerges from an analysis of these and similar tables, is that of a suitable, safe level of use or contamination. Figures of from 1/10 to 1/100 of the LC_{50} value for any group of animals are generally regarded as adequate to protect the animals from any acutely toxic effects. (This, of course, says little about chronic effects.) Levels of contamination (1/100 of LC_{50} for LM bass, for example) are found to be acutely toxic to many stone flies, waterfleas, amphipods, and mayflies. While the aquatic insect larvae may survive as populations due to the variable number of eggs laid and different stages of development - organisms

TABLE 5-D

THE LC$_{50}$ FOR VARIOUS FISH TO MALATHION (2)

Fish Species	Exposure Time (hr)	LC$_{50}$ (ppm)	Source
Harlequin fish	24	10	Alabaster, 1969
Brook trout	48	0.0195	FWPCA, 1968
Coho salmon	96	0.101	Macek and McAllister, 1970
Bluegill	96	0.103	"
Redear sunfish	96	0.17	"
Rainbow trout	96	0.170	"
Brown trout	96	0.200	"
Yellow perch	96	0.263	"
Largemouth bass	96	0.285	"
Carp	96	6.59	"
Fathead minnow	96	8.65	"
Channel catfish	96	8.97	"
Goldfish	96	10.7	"
Fathead minnow	96	12.5	Henderson, Pickering and Tarzwell, 1959
Black bullhead	96	12.9	Macek and McAllister, 1970

which compose the fundamental elements of the zooplankton community (Waterflea) may be seriously affected. While malathion at 0.1 ppm did not appear to exert an inhibitory effect on mixed algal culture total growth, it was converted to malaoxon (the toxic chemical). As such, the algae which forms much of the food for aquatic microcrustacea, while itself not affected by the pesticide, can convey toxic quantities of the chemical to the next trophic level of the food chain.

It has previously been pointed out that malathion produces different compounds upon hydrolysis, depending upon the pH of the medium. The relative toxicities of the different degradative products have been tested on very few animals at this time. The following hypothetical situation is proposed to identify the potential for harm. Assume late spring and early summer application of malathion near natural water (a pond), followed by relatively heavy rainfall. The addition of fertilizer elements from run-off plus the warmer temperatures are known to stimulate growth of phytoplankton and emergent vegetation; this stimulated growth is further known to make demands upon the free carbon dioxide content of water with consequent elevation of the pH. Alkaline pH fosters the hydrolysis of malathion.

Data is quite meager for LC_{50} acute toxicity measurements over a range of environmental tolerable pH's - but we know enough about the basic physiology of these organisms to know that some degree of stress in encountered as the pH rises above 85.

Now, we have a situation of warmed water and increased activity enhanced photosynthesis, elevated pH, toxic hydrolysis products, and an already slightly distressed animal. It is sufficient to point out that measurements of the total effect of this kind of combination of factors have not been made at present. We do know enough to identify the fact that LC_{50} measurements made under rigid laboraotry situations do not begin to cope with the aforementioned conditions.

Direct synergistic action resulting in increased toxicity has been presented (29) which indicates that one of the basic hydrolysis products, dithyl fumarate (which has a TL_m of 4.5 wg/l over twice the TL_m for the parent malathion and a result which would be produced by the hydrolysis of 64 percent of the parent TL_m concentration), and the parent malathion act to produce an effect greater than either one alone. Other proposed hydrolysis products are either more toxic than the parent or sufficiently toxic and capable of being produced in sufficient quantities to cause long-term damage. The hypothetical situation proposed sequential application of malathion 2-3 days apart which could result in hydrolysis products and the parent compound being washed into a common receiving stream is not altogether fanciful. To date, no data is available on either animals for either the products of malathion or possible synergistic effects. Table 6 is also valuable to point out the wide variation in response noted by different authors. Reports such as these which at the same time show the same 96 hours for one compound (Dimethyl phosphite = 225 ppm) and yet show such different response for others; Diethyl fumarate 4.5 vs. 38.0 ppm or Dimethyl phosphate 18.0 vs. 250 ppm).

Dimethoate, while not directly shown to cause injury to three species of mice in a natural population study, did, indirectly arouse a considerable change in the species' composition and absolute numbers of animals. No direct mortality to mice was observed nor was a change in habitat observed following spraying. Insects density declined sharply after treatment, suggesting that drift mammalian population composition reflected the decrease in insect food items. (30)

Changes in species diversity, although quite transient at times, has nevertheless been observed in a number of aquatic situations. If we know more about "base" levels of aquatic populations and their structure, we could probably identify a great many more.

TABLE 6-D

Compound	Author 1	Author 2	Other Authors
	96 Hrs. TLm (mg/1)	96 Hrs. LC50 ppm	
Dimethylphosphorodithioic acid	23.5		
Diethyl fumarate	4.5	38.0	
2-Mercaptodiethyl succinate	35.0		
Dimethylphosphorothionic acid	42.5		
Maleic acid	5.0	25.0	
Diethyl maleate	18.0	41.0	
Dimethyl phosphate	18.0	250.0	
Dimethyl phosphite	225.0	225.0	
Thiogylcolic acid	30.0		
Diethyl succinate	140.0	18.0	
Diethyl-dl-tartarate	650.0		
Bis (hydroxymethyl) phosphinic acid	29.0		
Ethylene phosphite	34.0		
Malathion	9.6	14.0	9.0 (3) 8.65 (4) 12.5 (5)

Considerable confusion seems to exist as to which is the preferential route of entry of pesticides into the bodies of aquatic organisms. There would appear to be no reason to debate any of the data presented by various authors. Although techniques vary, all appear to be reasonably consistent with physiological principles. Thus, the gill is suggested as the site of inward diffusion of pesticides (dieldrin) where it dissolves in the lipid portion of lipoprotein, in which form it is transported to and incorporated into the lipids of various tissues (31). Concentrations of 169-515 ppb in bath water resulted in plasma perfusate concentrations of 64-220 ppb. This results in a constant inward diffusion gradient; continued transport and storage; thus perpetuating the gradient. (32) Radioisotope techniques were utilized to show that brook trout accumulated almost ten times as much DDT from their food as from the water directly (33). Using comparative figures, pptr in water and ppm in food, they suggest that at their calculated rates, it would take the fish 12 years to accumulate 1 ppm total residues when exposed to a constant 3 pptr in water. Since yearling salmonids from lakes often contain 1-2 ppm in their first year of life, it is offered that the food chain is the major source of DDT concentration in fish. Any gilled animal, whether it be fish or invertebrate, probably takes a considerable portion of the potential contaminant into the body through the gills, oral surface, or skin. Food items which contain a pesticide food are likewise important routes of entry. Once inside the animal's body, the liver or hepto-pancreas appear to be the sites of active metabolic alteration of a great variety of chemical compounds.

Atlantic salmon degraded DDT to DDE and TDE within nine hours when immersed in solutions of the parent compound. (34)

Decrease in the total quantity of organochlorine in ovarian tissue of the winter flounder was observed as the spawning season progressed. The total of DDT, DDE, heptachlor, heptachlor epoxide and dieldrin was sequential concentrated from October 30 (0.21 ppm) to March 29 (1.29 ppm). Although less than one-half of that value was reported by Burdick (35) to cause fry death, these authors felt that the high larvae mortality observed in this species at final yolk sac absorption time could be the result of synergistic response or species tolerance differences (36).

The effects of intestinal microflora have been demonstrated to degrade certain pesticides (34). This general phenomenon, although minor, is nevertheless a known route to decay. DDT has a strong inhibitory effect on adenosine triphosphatese (Na+, K+, Mg^{2}+) at 5 ppm.

Noneverted intestinal sacs of seawater-adapted eels showed impairment of fluid absorption when bathed in DDT solutions. This impairment was seen to have an enzymatic basis. The DDT at 5 ppm producing a 43 percent inhibition of adenosine triphosphatase (Na+, K+, Mg^{2}+) activity in mucosal homogenates. (37)

Osmoregulatory impairment in teleosts is thought to be involved with sodium transport and an ATP mixed system. Organochlorines have shown such inhibition when investigated. Lindane, endrin, chlordane, and DDT inhibition of one or more ATP-ases from gill, muscle, brain, intestinal mucosae, and liver have been shown for a variety of freshwater and marine fish (38, 39).

In addition to inhibition of ATP-ase systems, organochloride insecticides has been observed to alter other enzymatic systems. Thus, dieldrin was lethal to the sailfish mollie within 72 hours at concentrations of 12 ppb and caused a significant increase in serum glutamic oxalacetic transaminase levels. (40)

The liver, in addition to or as a result of its being the site of more active in vivo degradation of pesticides, is also the site of greatest enzyme induction. As previously stated, the effect of enhanced microsomal induction of enzymes may be the most serious single biochemical event.

The effect on disturbed steroid metabolism and the consequences observed in raptorial and fisheating birds is well documented.

It was found that induction of mixed function oxidase system enzymes required a halide substituent on each phenyl ring and there halid in the α position of the ethane moiety. Substitution of other radicals in these positions was ineffective as an inducer. Removing some of the chlorine atoms (DDD) abolished the induction also (41). Thus, rather strict specificity is indicated for the induction of systems specifically effective in degrading DDT in mammals. Although not identified at this time, such specificity can probably be found in all vertebrates.

Young coho salmon were observed to succumb to DDT in diets in direct proportion to their size. Younger fish consumed a proportionately greater amount of food for their body weight and thereby received the highest dose (42). This feature is common to all young animals which are in an active phase of growth.

Dieldrin was demonstrated to reduce growth rate in 160 and 230 day experiments with guppies continually exposed to 1.0 and 2.5 ppb. While lower levels seemed to increase the intrinsic rate of increase, at higher levels (2.5 ppb) the intrinsic rate of increase was reduced by a combination of lower total reproduction, increase in number of aborted broods and delay in age of first reproduction. Postnatal survival was not expected at concentrations up to 2.5 ppb (43).

Unfortunately, it is easier to age and separate fishes by age than it is to identify different age groups in many invertebrates. Many studies have indicated that different aged fishes may accumulate and store pesticides at differing rates. Effects of the age of fishes of the same species have been identified. It is not known whether changing food habits or differential exposure and/or storage is responsible. Differences between species may certainly reflect differences in feeding habits but does not preclude the fact that inherent differences in the basic physiology of the animal is involved. A general increase in tissue levels is indicated as fishes increase in age (see SMB and salmon). It should also be noted that no direct relationship appears to exist between the storage of dieldrin and/or DDT although all animals are theoretically exposed to the same concentrations. Although not documented by anyone, it would appear that such differences could accrue largely from the levels of residues in food chain organisms. Differences in retention rates are not ruled out.

It would be extremely desirable to identify differential rates of uptake in a variety of aquatic invertebrates under common environmental variables as well as for fishes. We really do not know what circumstances lead to rate of uptake, body partition, or elimination in our more valuable fishes of fish food organisms. For example, why are the tissue levels of a particular pesticide the same in a one-year old fish of one species; a five-year old fish of another species, or a three-year old crayfish, all from the same environment?

Artificial loading of aquatic organisms has yielded some interesting data. When organochlorides of widely different structure were tested with small sunfish and goldfish sublethal levels (0.03 ppm), the labelled compounds were picked up by the fish. Lindane, accumulated during the period of exposure was eliminated by fishes within two days of recovery, dieldrin was 90 percent eliminated within two weeks, but DDT was eliminated less than 50 percent of accumulated level after one month. Flow-through recovery tanks was sufficiently slow to allow non-contaminated fishes to pick up excreted dieldrin and DDT from the previously exposed fish. Of course if this was possible, some of the eliminated compound could have been re-accumulated by the test fishes. Such studies do not account for continued exposure resulting from diet under natural conditions and no metabolites were measured. Since dieldrin is rather clearly eliminated under these conditions it follows that studies such as those which showed a parollee contamination of flesh are indicative of contrived contamination by dieldrin to these animals.

The value of such studies appears to be somewhat underrated and it is felt that further study along this line is warranted.

Fishes which have an acquired resistance to certain organochlorine pesticides have been demonstrated to release sufficient compound or its metabolites into water to kill non-resistant fish very shortly.

Low, marshy areas around and within many suburban areas are particularly troublesome to vector control officials; they likewise are very desirable breeding grounds for many amphibians. Local heavy damage to many common frogs and toads could occur during the spring - especially during the periods of maximum home and garden use. Static bioassays suggested that endrin and some other chlorinated hydrocarbons were quite toxic to several common species, however, lindane was the least toxic insecticide (44). Endrin and dieldrin have been demonstrated to be quite toxic to other frogs as well. Unlike other pesticides, the toxicity of some of these compounds appears to increase with the increase in exposure time.

Of particular note is the fact that the younger animals (1-3 weeks) were less sensitive, generally, than older tadpoles (7 weeks). The greatest degree of change in sensitivity was seen during the period of 4-5 weeks and characterizes many of faster growing frogs' period of intense body reorganization associated with metamorphosis. Dramatic changes in osmoregulatory ability, nitrogen metabolism, and Krebs ornithine cycle enzymes induction, thyroid activity and morphological changes of increased weight, tail rescription, loss of external gills, etc. are common.

It appears that as the skin assumes a greater ion regulatory and respiratory role it also may be involved in toxic transport. It is also interesting to note that toads become increasingly more sensitive to DDT with age. The fact that 96 hours TL_m of seven-weeks-old animals is 6 to 7 times the 24 hours TL_m for these animals compared to one-week-old animals suggests longer exposure periods are much more detrimental to older aged animals than younger. It would be desirable to have such data for many more species and chemicals before a firm statement can be made.

Quantities of pesticides found toxic to frogs and toads are not generally found to be toxic to fishes. However, the problems encountered with fishes tends to be one of chronic exposure generally and not associated with acute toxicity directly. To what extent frogs, toads, and salamanders might accumulate pesticides in the insects they eat can only be speculated at this time. Moderately high residues have been found after repeated applications of aldrin (dieldrin) to fields, in insects, frogs, toads, and snakes (45). Additional residues have been identified in coastal surveys (46), marshes (47), and estuarines (48). To what extent any of these residues in amphibians could produce acutely toxic effects on fishes feeding upon them is unknown. It is likewise unknown whether the residues currently accumulated by amphibians affect their growth, reproduction, longevity or health in any way under prolonged sublethal exposures.

Diets of 0.0, 0.3, and 2.0 ug/g B.W. of endrin for one month prior to spawning produced a large incidence of deformity in fry of the channel catfish. The following types were identified:

Tail-less	44 ± 9%
Spinal curvature	8 ± 3%
Large mandible	9 ± 2%

That this result was due to the treatment and high residues is borne out by the fact that brood stock from the same source and maintained on pesticide-free regimes for 2 years, exhibited fewer than 3 percent deformed progeny. (49)

Lake trout fry sustained a heavy mortality at hatching when egg fat content reached 2.05 ppm or above (35). Fry of the Sebago salmon had 76 ppm DDT in fat, 24 ppm DDT one week after yolk sac absorption. On a wet weight basis, this was 0.76 ppm; no mortality was observed (50).

Gonad development was reduced and a lowered gonadosomatic index was evident in goldfish chronically exposed to endrin, through feeding at levels .43 ppm and .143 ppm in food. These figures are not inconsistent with levels observed in natural food organisms (25).

Similar injury to sac frey of the cutthroat trout was noticed and reported as early as 1963 (51). More recently, studies have demonstrated this in brook trout eggs. The release of DDT by metabolized phospholipids is probably of greater importance than the utilization of triglyceride oil droplets as previously through (52). These studies indicate that the greatest phospholipid mobilization occurred at 65-70 days, the period of dinal yolk sac absorption and greatest fry mortality.

Submersing carp eggs in various insecticides resulted in 50-100 percent mortality above 5 ppm; none caused significant mortality below 1 ppm, leading the researchers to conclude that carp embryos are less susceptible to pesticides in the water than are adults. Whether or not uptake and accumulation reached levels known to be detrimental to trout and salmon was not determined. Chlordane was found to be responsible for slightly increased viability and apparently stimulated development time. Additional data is desperately needed to determine whether chemicals like chlordane can stimulate microsomal enzyme induction and thereby effect developmental rates in fishes (53).

Subtle, difficult-to-identify changes in behavior associated with sublethal, chronic exposure to pesticides is not as well documented as are the results of acute toxicity. Aquatic organisms do exhibit behavioral changes in response to pesticide exposure. The chlorinated hydrocarbons including the cyclodienes are known to affect both central and peripheral nervous tissues in mammals and birds. Behavioral alterations which reduce alertness, increase restlessness, reduce visual acuity or otherwide are responsible for exposing the animal to capture or debilitating injury all have a damaging effect on the long-term success of the species.

Brook trout, exposed to DDT at sublethal concentrations of 100-300 ppb increased the duration of response to a simple mechanical disturbance. The response is greatly potentiated by cold. The greatly increased instability in sensory nerve fiber firing in the cold suggests that DDT (and perhaps other compounds as well) may be more lethal in colder temperatures. A constant barrage of uncoordinated bursts may easily reduce the animal's vigilance (54). Twenty parts per billion of DDT for 24 hours was sufficient to seriously reduce the ability of brook trout to respond to training. Training, per se may not be a very meaningful parameter, however, since other authors report no effect, even at high dose levels. The fact that chronic exposure to sublethal amounts of chlorinated hydrocarbons might alter a fish's natural repertoire of conditioned responses and hence make it less fit to survive in a highly competitive environment is suggested.

The organophosphorus compounds are potent cholinesterase inhibitors. For the most part, they are either effective in killing the animal in question or will degrade shortly to non-lethal levels. Intoxication may not kill the animal outright but often will allow a degree of exposure which will subject the animal to capture and death. Rapid degradation is probably responsible for the relative lack of observed resistance as the organophosphorus compounds don't usually remain around long enough to exert a significant influence on a large enough population. Rather than being a boom to the species or the ecosystem, it appears that resistance has far greater biological and ecological significance. The inescapable fact is that any such resistance implies a genetic change in the target species. Any compound capable of affecting one such change in the genome can conceivably be responsible for many more unidentified changes which might spell doom for the species.

Another undesirable feature of such resistance is that resistant species can develop massive body burdens of persistent compounds which, when incorporated into the food chain, could easily prove fatal to susceptible organisms higher in the food chain. Examples of such resistance show that prior exposure can result in animals which are as much as several hundred times as resistant than previously unexposed numbers of the same species. To what extent this build of resistance occurs in other aquatic organisms is unknown at present. Over 200 species of aerial insects (flies, mosquitoes, midges, etc.) have demonstrated resistance - it should not be surprising to find other insects with varying degrees of resistance.

Aquatic Food Chain

There is abundant evidence to point to accumulation and biomagnification within aquatic food chains. The fact that we do not see many cases of outright death to fishes in no way detracts from the potentially harmful effects of chronic exposure to this group. Ecological efficiencies of about 10 percent per trophic level are common. Biomagnifications of nearly one order of magnitude are seen to occur at each of the lower trophic levels. Residue values for higher trophic levels may or may not reveal such magnification due to differential rates of metabolism and degradation. The fact that the residues of top trophic levels do not reflect such magnification at any given sampling does not mean that the animal was not subjected to the potentially harmful influence of metabolizing heavy body burdens of chemicals.

Limited data exists for other aquatic animals. What is available suggests that toads, frogs, and salamanders may be highly susceptible to the levels of pesticides which might occur from suburban and municipal pesticide use. These groups, along with snakes and turtles, are virtually unmentioned in the literature. Clearly, much research is needed.

Those birds which feed on fishes and other aquatic life can be regarded as the top carnivores of aquatic chains. Adequate documentation is available to point clearly to reproductive failure and diminished population numbers. Hepatic microsomal enzyme induction and disturbed steroid and calcium metabolism areprobably at fault.

The examples of biological magnification cited previously give good indication of the complexity of the problem. The literature is filled with examples of applications of chlorinated hydrocarbons which have worked their way into food chains and up the trophic structure ultimately to contaminate and lead to the destruction of top members of aquatic food chains.

Examples which have reached the popular press include declining numbers of predaceous and piscivorous birds, eagles, ospreys, the peregrine falcon, and sparrowhawks in the United States with parollee species in Europe. Obviously a certain amount of emotion and sentiment appear attached to these magnificant species, and caution must be exercised to insure that emotions do not ride roughshod over the facts. It is apparent to the contractor that sufficient scientific work of high quality has been produced to justify the stated concern of world biologists and scientists.

More recently, other species of birds, not as romantic in our thinking as the raptores, have been identified to accumulate pesticide residues from their environment with a consequent measured reduction in their breeding success. Examination of Lake Michigan's ecosystem by numerous workers has clearly shown the residue accumulation of the DDT family through various trophic levels starting with bottom sediments and ending in certain ducks and gulls. Residue analysis shows a concentration from sediment to invertebrate of about 50 fold with a factor of about 10 fold for the fish which eat the invertebrates and another 15 fold for birds eating fish. Specific organs, especially fat, show considerably higher magnifications. (55) One point which should be emphasized is the unbelievable quantity of work which must go into identifying these concentrations. The contractor is convinced that some of the burden of the physical work as well as the costs of these studies must be borne by manufacturers and users of pesticide compounds in the future.

Other studies, although not nearly so well documented as the ones above, suggest very strongly that shore and marsh inhabiting birds (herons, egrets, bitterns, gallanales, etc.) which eat fish, frogs, crayfish, and other invertebrates, have declined in certain estuarine and coastal areas in the last 20 years. (56) It must be remembered that much of the basic biology of these birds is poorly understood at this time so it should not be too surprising to realize that we are at something of a loss to identify real damage at the population level. Just how subtle the interrelationship can be is typified by studies with the Bermuda Petrel, a bird which has declined in population steadily over the past 20 years. The islands on which the bird breeds have never been treated with DDT or its residues - the body burden which apparently is responsible for the decline comes solely from an oceanic food chain - contaminated on a global scale by inland and coastal use of these pesticides. (57) That quantities of pesticides have found their way into the water, then to plankton and fishes in the ocean, is undisputed by responsible scientists at this time. The situation in fresh water is potentially more devastating due to the use of chlorinated hydrocarbons. Here although we know quite a lot about the obvious aspects of the biology of game and other commercially valuable species, we are only at the threshold of understanding the interrelationship of trophic structure which support populations of these organisms. It has been pointed out that the basic biology of lower trophic level organisms is virtually unknown.

Few strictly freshwater ecosystems have been so exhaustively studied as some estuarine areas, Table 7-D (56). The amount of labor involved and the actual cost

TABLE 7-D

DDT RESIDUES IN CARMANS RIVER ESTUARY (48)

DDT residues (DDT+DDE+DDD) (*1*) in samples from Carmans River estuary and vicinity, Long Island, N.Y., in parts per million wet weight of the whole organism, with the proportions of DDT, DDE, and DDD expressed as a percentage of the total. Letters in parentheses designate replicate samples.

Sample	DDT residues (ppm)	Percent of residue as		
		DDT	DDE	DDD
Water*	0.00005			
Plankton, mostly zooplankton	.040	25	75	Trace
Cladophora gracilis	.083	56	28	16
Shrimp†	.16	16	58	26
Opsanus tau, oyster toadfish (immature)†	.17	None	100	Trace
Menidia menidia, Atlantic silverside†	.23	17	48	35
Crickets†	.23	62	19	19
Nassarius obsoletus, mud snail†	.26	18	39	43
Gasterosteus aculeatus, threespine stickleback†	.26	24	51	25
Anguilla rostrata, American eel (immature)†	.28	29	43	28
Flying insects, mostly Diptera†	.30	16	44	40
Spartina patens, shoots	.33	58	26	16
Mercenaria mercenaria, hard clam†	.42	71	17	12
Cyprinodon variegatus, sheepshead minnow†	.94	12	20	68
Anas rubripes, black duck	1.07	43	46	11
Fundulus heteroclitus, mummichog†	1.24	58	18	24
Paralichthys dentatus, summer flounder‡	1.28	28	44	28
Esox niger, chain pickerel	1.33	34	26	40
Larus argentatus, herring gull, brain (d)	1.48	24	61	15
Strongylura marina, Atlantic needlefish	2.07	21	28	51
Spartina patens, roots	2.80	31	57	12
Sterna hirundo, common tern (a)	3.15	17	67	16
Sterna hirundo, common tern (b)	3.42	21	58	21
Butorides virescens, green heron (a) (immature, found dead)	3.51	20	57	23
Larus argentatus, herring gull (immature) (a)	3.52	18	73	9
Butorides virescens, green heron (b)	3.57	8	70	22
Larus argentatus, herring gull, brain§ (e)	4.56	22	67	11
Sterna albifrons, least tern (a)	4.75	14	71	15
Sterna hirundo, common tern (c)	5.17	17	55	28
Larus argentatus, herring gull (immature) (b)	5.43	18	71	11
Larus argentatus, herring gull (immature) (c)	5.53	25	62	13
Sterna albifrons, least tern (b)	6.40	17	68	15
Sterna hirundo, common tern (five abandoned eggs)	7.13	23	50	27
Larus argentatus, herring gull (d)	7.53	19	70	11
Larus argentatus, herring gull§ (e)	9.60	22	71	7
Pandion haliaetus, osprey (one abandoned egg)‖	13.8	15	64	21
Larus argentatus, herring gull (f)	18.5	30	56	14
Mergus serrator, red-breasted merganser (1964)‡	22.8	28	65	7
Phalacrocorax auritus, double-crested cormorant (immature)	26.4	12	75	13
Larus delawarensis, ring-billed gull (immature)	75.5	15	71	14

has been prohibitive. It should be mentioned that a coherent plan and truly imaginative approach has also largely been lacking. One fruitful line of attack is seen in radio tracer studies (58). Many more studies of this kind are needed to identify effects.

Primary Production: Any energy-yielding or energy-requiring system must have the source of that energy identified. Photoshythesis and carbon fixation are fundmental to the support of succeeding trophic levels. An understanding of the effects of pesticides on this basic biochemical and life support system is therefore essential. Natural bodies of water are quite diverse, as are the forms of vegetative life they support. Oceanic water masses and impounded or semi-impounded waters accomplish carbon fixation, primarily through the action of free floating phytoplankton, green plants which, by definition, have very poor or no means of self-mobility. Rivers and other flowing waters, because of the movement of the water mass, support relatively few freely floating plant forms. Forms attached to the substrata, diatoms, coccoid, and filamentous algae, accomplish a part of the photosynthetic task in these waters.

More recently it has been shown that often as much as 75 percent of the total energy-yielding food base in streams does not arise in the stream itself, but comes from the watershed in the form of bits of fragmented plant material. This allochthanous material could bring to the stream accumulated quantities of pesticide materials, along with loads of silt and running water, each contributing its share.

Each of these sources, including that portion of airborne pesticides brought in by rainfall directly (previously co-distilled from the global environment) assure that pesticide compounds find their way into the water environment. Now, do these compounds actually exert a harmful effect on the total global photosynthetic picture, or, depending upon local conditions, a sufficient effect on photosynthesis in general to merit our concern?

DDT, when applied to laboratory cultures of coastal and oceanic phytoplankton species was sufficient to reduce photosynthesis in all at concentrations less than 1.0 ppb (59). It is emphasized that although such a level is high for the open ocean, it would be of the same order of magnitude as other authors have found for natural waters under certain circumstances (133 ppb in Florida salt marsh for 1 week following DDT spraying; 22 ppb in some California coastal waters; and 14-20 ppb added directly to Clear Lake, California). Levels far in excess of 10 ppb have been recorded at outfall sources in freshwater streams and lakes. The ecological importance of such physiological stress as is imposed by DDT is that species composition may be altered, allowing species which may normally be suppressed by others to "explode" and dominate the community for varying periods of time. Thus, the normal ecological succession is disturbed and community structure upset. The influence of varying toxic susceptibility is indicated in other studies (60) which show that some forms from different oceanic environments show dramatically different responses to DDT, dieldrin and endrin in culture. One species was inhibited by all of these pesticides at concentrations above 1 ppb with cell division markedly reduced at 0.1 ppb, while another species was completely insensitive to these ranges. This extreme difference serves to further emphasize the dramatic influence on succession and dominance of algal populations referred to above.

Secondary Trophic Structure

No one has yet identified any loss to aquatic food chain organisms resulting directly from the home and garden use of pesticides from the three study cities or any other urban areas. It is apparent, however, that the use of chlorinated hydrocarbon compounds by home and garden users does contribute an additional burden of these compounds to the environment. From what we know about degradation of these chemicals, it is also apparent that rates of degradation are not efficiently fast to free us from their harmful effects.

Work already referred to on natural communities of periphyton (61) is valid for an assessment of total accumulation of pesticides. It does not, however, identify the response of native periphyton communities to these pesticides. One such study which does utilize an ubiquitous, naturally occurring freshwater algal species indicates that DDT, dieldrin and toxaphene all decreased cell numbers at all levels of treatment in culture. In addition, total biomass and the rate of carbon assimilation was reduced (62).

Static bioassays with three species of stoneflies (63) indicated that endrin and dieldrin were the most toxic organochlorides used out of 38 different commonly used pesticide compounds. Differences between species is indicated as well as differences between sizes of the same species; the smaller (younger) individuals being more susceptible than larger (older). Carbamates and organophosphates were generally less toxic to stonefly naiads. It might also be mentioned that the symptoms of intoxication, increasing irritability, loss of equilibrium, tremors, convulsions, are precisely those features which would tend to expose these organisms to capture, ingestion, and incorporation into the food chain.

DDT and DDD were the most toxic compounds to cladocerans, important members of the freshwater and marine food chains.

Differences in toxicity between species is observed as well as differences between potency of certain insecticides.

Mention has already been made to the fantastic biomagnification possible in certain members of the food chain.

One point which emerges from both acute and chronic exposure studies is the fact that such a variety of responses is seen that every compound will probably have some effect on at least one organism (perhaps many more) at each different trophic level. The question then becomes one of properly assessing the impact of the most susceptible species to the entire ecosystem. Species which are not eliminated directly are seen to pose a real hazard in their ability to pass the compound along to other trophic levels with potentially disastrous results later.

It is becoming increasingly evident that total metabolism may be altered at all trophic levels. Of equal importance is the suggestion that metabolic pathways may be altered in response to pesticides. Such subtle alterations in pathway in the food chain organisms could have far-reaching consequences on total energy budgets for the ecosystem (64). Clearly more work of this kind needs to be accomplished before a total assessment of effects on the ecosystem structure can be made.

Fishes

A large number of publications have presented data on acute and chronic toxicity to fish and other aquatic organisms, of a wide variety of pesticide compounds. Unfortunately, very few of these have utilized aldrin or dieldrin of the insecticides or atrazine of the herbicides. The body of published information on DDT alone would fill volumes. Due to the paucity of information on aldrin, we have decided to review selected papers dealing with DDT where they demonstrate a particularly valuable point and other cyclodienes, as their mode of action might be expected to reflect the action of aldrin/dieldrin. It has been suggested by several authors recently that considerably more effort could and should be directed at studies utilizing organophosphates and carbamates since it is hoped by many that these less persistent compounds will eventually replace the more persistent organochlorides.

In a study of relative pesticide susceptibility to some common fishes, it was found that considerable differences existed not only between classes of pesticide compounds but between the various families of fishes (65). It was possible to establish a range of species susceptible - a hierarchy of response. It was not possible to relate chemical structure absolutely with the observed response but it was suggested that such hierarchial rankings could be used to predict responses to fish populations. The point is that such an evaluation does appear to have merit, but is rarely applied by workers. It was pointed out, and should be emphasized, that safe levels based on assays with one group might be extremely hazardous for another.

Analysis of inherent biological variability as reflected in variability in genetic constitution and physiological condition of the test species is identified as being responsible for the wide differences observed to the same toxicant (66) (see Table 8).

TABLE 8

-The mean TL_{50} and coefficient of variability of p,p'-DDT for fish and aquatic invertebrates. The 96-hour values are given for fish and the 48-hour values are given for invertebrates

Species	Number of tests	Temperature (C)	TL_{50} (µg/l)	
			24 hours	48 or 96 hours
Rainbow trout *Salmo gairdneri*	15	12.5	9.6 (27)[1]	7.2 (30)[1]
Fathead minnow *Pimephales promelas*	14	18.5	24.6 (47)	19.9 (39)
Channel catfish *Ictalurus punctatus*	10	18.5	25.8 (34)	17.4 (17)
Bluegill *Lepomis macrochirus*	18	18.5	14.7 (35)	9.5 (37)
Largemouth bass *Micropterus salmoides*	13	18.5	3.9 (28)	1.8 (28)
Daphnia *Daphnia magna*	11	21.1	–	4.0 (15)
Seed shrimp *Cypridopsis vidua*	10	21.1	–	54.0 (15)
Sowbug *Asellus brevicaudus*	9	15.5	7.8 (19)	4.7 (15)
Glass shrimp *Palaemonetes kadiakensis*	11	15.5	6.9 (20)	4.2 (17)
Damselfly *Ischnura verticalis*	9	15.5	60.0 (22)	22.5 (35)
Scud *Gammarus fasciatus*	17	15.5	10.4 (31)	3.6 (30)

[1] Coefficient of variability.

The importance of this feature of testing as it relates to the significance of acute exposures can hardly be overemphasized. The fathead minnow showed the greatest variation in susceptibility. It is unfortunate that data for the goldfish is not included since this species is routinely used in such studies and for registration applications.

Various metabolic effects have been noted in fishes. Thus, treating immature rainbow trout with 1.0 mg dieldrin/kg. BW (140 days) and subjecting to forced swimming for 24 hours. Total serum amino acids in control and DDT treated fish were decreased. Significantly, dieldrin exposed fish did not decrease. It was concluded that amino acids were preferentially utilized by dieldrin treated fish while fat and carbohydrate was preferentially used by DDT and control groups for an energy source during the first week of forced swimming.

RBT subjected to loading with DDT and dieldrin and then forced to swim showed that stressed dieldrin treated fish lost 32 percent more weight during two weeks of stress than similarly treated controls or DDT loaded fish. The loss of weight of these two latter groups was 60 percent more than fasted groups of fish, however.

Measurements of losses of mesenteric fats during the forced swimming showed that DDT was not appreciably metabolized until the depot fat was about depleted, then rapid mobilization and brain and liver inflamation, followed by death. Little fat was mobilized by stressed dieldrin treated fish during forced swimming (previously described) (67) and elimination followed predicted elimination half-life. Thus, a basic difference in the metabolic response of fish is noted between these two compounds.

The importance of diet control in toxicological studies has been pointed out (68) in studies which showed that DDT and dieldrin acted synergistically when fed in combination to rainbow trout. More DDT was stored in the brain of fishes on low methionine diet than in those on high methionine diet.

A similar feature has been noted in rats and dogs and may be a general vertebrate response to combinations of these two chemicals.

Data has been presented to indicate that dieldrin and DDT both increase lipogenesis in the rainbow trout (69). Furthermore, the effect of both of these organochlorides was additive and more significantly, it took several months of exposure to cause this effect. Feeding combinations of DDT and dieldrin resulted in the trout retaining relatively more of the total load of DDT than of dieldrin. Thus, 98 percent of the DDT was retained after 56 days and 50 percent of the dieldrin was eliminated in less than 14 days. It is suggested that the fish have a greater capacity to metabolize and/or excrete dieldrin than DDT.

Data on responses of fishes to atrazine are absent. Simazine, a substituted triazine, has been utilized and, as most other herbicides, found to be far less toxic than insecticide compounds.

Concentrations of simazine g 0.1, 0.3, 1.0, and 3.0 mg/e (ppm) resulted in residues of 0.0, 0.1, 0.3, and 0.5 ug/gm (ppm) in bluegill reared in these treated ponds. Dead and decaying vegetation lend an immediate and temporary enriching effect but this was ultimately offset by a decrease in net primary production. Although it was not commented upon, gross shifts in CO_3/HCO_3 ratios resulting from the treatment could have dramatic effects on feeding and food utilization by the fish (70).

Features of the environment which alter respiratory rates such as the above might augment the harmful effects of pesticides.

It has been pointed out by many authors that monitoring of pesticide levels in fishes has certain obvious advantages. We might add that the manner in which some monitoring is conducted has certain obvious disadvantages as well. Residue levels which have been published tend many times to confuse rather than illuminate. The following items (largely from Hickey (55)), are quite valid today. It is noted that the demonstration of residue levels in fish of no biological significance is impossible to identify at this time. This, of course, is precisely what the problem is all about. Levels of intake which were exactly balanced by degradation rate could theoretically produce no residues. This has not been the case, even though we do not have enough data to completely substantiate such a statement. The production of some residues and their concentration in larger fish, fish-eating birds, and other piscivorous species, could have several effects. It is stated that there is presently no test of the no-effect hypothesis. Clearly there is not. Even the acceptance of "safe" level is anathema for it spells out levels of exposure which we are willing to accept without really knowing the consequences. It would appear that "safe" levels have validity in the more rapidly degraded substances which do not tend to accumulate. Such a category for persistent pesticides is probably unwarranted under any circumstances due to the abilities of many organisms to magnify the compound.

Depressed reproductive success on adult fishes directly or on species which feed on fish are clearly indicated in numerous studies. It would appear that additional monitoring data plus controlled laboratory studies are required to identify the possibility for harm here. Direct mortality is often equally difficult to identify - as has been pointed out - the dead do not remain long in a properly functioning ecosystem - many times not long enough for us to measure residue levels and relate them as cause of death. It has also been noted that alteration of lower trophic level populations could result in lowered food stocks which could lead to death of higher food chain species. This could develop in two distinctly different ways. First, simply not enough food to support the higher level populations under times of severe stress or, second, the utilization of body fat stress which would release into circulation levels of pesticides which would then become lethal or sublethal. We have seen that hard data of this kind from natural populations of animals is largely lacking. Reproductive failure of fishes themselves has been commented upon. Death of lake trout fry, and some morphological abnormalities in catfish fry are pitifully slight evidence of such effects. As we have indicated elsewhere, the results of such effects are rarely seen due to their rapid removal. Declining strength of year class, years later, can always be attributed to other of man's activities including over exploitation of a stock of fishes - it would be impossible to lay the blame directly on pesticides with the present state of our knowledge. Levels of dieldrin carried by channel catfish in Iowa streams would appear to be sufficient to result in reproductive failure of some kind - but have not been identified with any certainty. How many other reproductive failures in the minor fishes of any ecosystem can only be imagined at this time. The measurements simply have not been made.

The number of cases of direct mortality to adult fishes is likewise very meager. Certain examples show an obvious cause and effect relationship. Under normal agricultural and home and garden use it is unlikely that direct mortality will occur. The subtle, difficult to measure, and almost impossible to identify analysis of sublethal exposure is regarded as the more pressing need.

Synergistic Effects

As described earlier in this report, home and garden pesticides contain a great variety of different chemicals as active ingredients. Occurrence of synergistic effects is therefore definitely a possibility, between different chemicals formulated together into one product as well as between chemicals which may arrive at the same site in the environment from separate applications.

Synergism is present when the effect of two chemicals applied together is greater than the sum total of their independent effects. Among pesticidal chemicals, a number of instances of synergism have been reported. The commercially most successful application of this phenomenon is the enhancement of the insecticidal effectiveness of pyrethrins by "pyrethrin synergists" such as piperonyl butoxide, sesamin, and others. Many other cases of synergism between pesticides have been reported in the literature. Most of these were observed in terms of increased toxicity of the combined chemicals to laboratory cultures of insects, or to laboratory mammals.

Very few investigators have addressed themselves to possible synergistic interactions between pesticidal chemicals or their residues in the environment after application. The contractor's search of the literature in this regard did not yield any reports applicable to the present study. This is an area which is very little explored.

It should be pointed out that field research in this area is regarded as extremely difficult due to the multiplicity of environmental factors involved.

Health Hazard to Humans

The primary health hazard to humans would appear to arise through the careless use of organophosphate and carbamate compounds. As the more persistent chemicals are eliminated from use, the use of these alternatives can be expected to increase. Most of these compounds are considerably more toxic to warm blooded animals than are the organochlorides. Standing in spray drift or other physical contact with concentrated solutions will pose a threat from these potent cholinesterase inhibitors. Ingestion of these compounds by children, with tragic consequences, through the careless handling of the original package, is sure to increase unless the full support of state and local authorities can implement a workable plan of education and information.

Recommendations

1. Support additional needed research in the area of synergistic effects of pesticides with each other and in combination with other environmental variables; particularly effects of reduced oxygen tension, pH, alkalinity, temperature, heavy metals, etc.

2. Establish improved monitoring systems which would identify levels of contamination at various trophic levels especially in and around major metropolitan areas.

3. Support laboratory and field studies on long-term effects on growth and population dynamics. These should include experiments designed to examine the effects of pulsed (repeated) exposures to sublethal concentrations of more acutely toxic compounds. All elements of aquatic ecosystems and trophic levels must be stressed.

4. Establish basic guidelines for the conduct of experimental research programs. The thrust of this should be toward insuring greater conformity and achieving greater comparability between data. Especially useful data should be sought which identifies rates of accumulation under varying conditions, particularly concentrations, and total quantity of chemical the test animals are exposed to.

5. Support basic research on the effects of combinations of pesticides most commonly used by home and gardeners on primary carbon fixation.

6. Institute a workable plan of information retrieval for all elements of the aquatic ecosystem as well as terrestrial. Compliance or voluntary cooperation is absolutely necessary by each state. Support may have to come through Federal withholding of support monies. Such a plan could make already gathered data available for analysis as well as predicting where duplication of effort might occur.

7. Continue to support and expand studies on basic physiological responses of fish and other aquatic vertebrates to pesticides under chronic sublethal exposure. This ought to include expanded studies of effects of heavy metals/pesticides synergisms.

8. Establish a means whereby the kinds of information generate, if produced by manufacturers or formulators, is subject to examination by the at-large scientific community - with due regard for corporate integrity and confidentiality.

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APPENDIX E

ALTERNATIVES TO THE USE OF CHEMICAL HOME AND GARDEN PESTICIDES

Pesticides for use in homes and gardens are usually applied in homes and gardens for aesthetic reasons as compared to the economic reasons behind agricultural use. Leaving weeds, insects and plant diseases uncontrolled does not directly affect a loss of yield or income for the suburban resident, although it may result in an indirect economic loss if these uncontrolled weeds, insects or diseases become so devastating that they destroy lawns, trees, shrubs, or other plantings, thus reducing the value of the property. However, such severe pest damage does not occur often in suburban areas, and where it does occur, its extent is limited to the cost of replacing the destroyed lawns and plantings. Therefore, suburban gardeners are not subject to the same economic considerations and pressures which influence the use of pesticides in agriculture.

In general, suburban gardeners also have a very limited knowledge of the weeds, insects, and diseases--they wish to control. An understanding of the biology and the life cycles of these pests is prerequisite to the intelligent and selective use of pesticides. This lack of knowledge by suburban gardeners is a major obstacle in the development of more prudent pest control methods. It also creates a great incentive to the development of multi-purpose pesticide products, based on the principle that if one uses a large enough hammer, it is not necessary to pinpoint the bug.

Another obstacle in the development of non-chemical methods to control lawn and garden pests is the great variety to be dealt with. Unlike farm crops, suburban gardens are not monocultures, instead containing different plant species affected by many different insects, diseases, and weeds.

At present, much work is devoted to the development of alternative control measures for some of the major agricultural pests, including biological and microbial agents, juvenile hormone mimics, insect attractants, sterilization by chemical or physical agents, etc. Efforts are also being expended to develop "integrated control" or "pest management" systems in which all available cultural, chemical and non-chemical methods for control or repression of a pest or pest complex are combined so as to obtain optimal (but not necessarily maximal) crop protection with minimal environmental damage.

These efforts are, by necessity, target-specific in terms of a single important pest species, or a complex of pests affecting a specific crop. Since a great variety of host plants and pest organisms exist in the home, lawn, and garden situation, it is not likely the developments discussed above will be as useful here as in agricultural settings.

Organic gardening methods appear to be the most important non-chemical methods of home and garden pest control currently in use. In the three study cities, the contractor found organic gardening organizations, pesticide task forces and similar groups at work interested in reducing or eliminating the use of chemical home and garden pesticides. Group members are informed about the dangers from pesticide pollution; from the use of persistent, broad spectrum pesticides; from residue accumulation of persistent pesticides in the soil and in the environment; and from improper disposal of "empty" pesticide containers or leftover concentrated or dilute pesticides. They provide information on those less persistent chemicals to be utilized when use of pesticides is unavoidable.

The importance of good housekeeping, mulching and generating a healthy environment for plants in general is also stressed.

Beneficial insects such as the praying mantis, the lady-bird beetle and the trichogramma wasp are recommended, along with sources of supply. Marigolds are suggested for interplanting with tomatoes, beans, eggplants and other vegetables to repel grubs and nematodes. Asparagus reportedly also repels nematodes. Nasturtiums are recommended to prevent aphids on cucumbers and tomatoes interplanted with them. Recipes are offered on spray preparation from peppers, onions, garlic, cloves and other ingredients to control a variety of foliar insects on flowers and vegetables.

As outlined in Appendix A of this report, only a small percentage of the homeowners surveyed during this study reported gardening organically; 2.5 percent of all respondents reported complete success and satisfaction with organic gardening methods. A somewhat larger group reported using organic gardening methods, supplemented by sparing use of chemical pesticides where absolutely necessary.

The great majority of the homeowners surveyed reported using home and garden pesticides without serious reservations, and without observing undesirable effects on their own health and well-being or on the environment. However, from personal contacts with suburbanites and leaders of gardening organizations, it was obvious that most suburban gardeners are quite aware of the "pesticide problem" and its international, national, and local implications. This was especially true in Michigan, where major legislative and regulatory steps toward control of pesticide use have been achieved.

The contractor feels suburban gardeners are not only very aware of environmental problems, but also very receptive to educational efforts and advice on how they can contribute directly to preserving and improving the natural environment. However, it is also difficult for many to find any realistic middle ground between the two extremes. At present home gardeners are given a choice between complete and immediate abandonment of all chemicals as opposed to complete reliance on chemicals, and especially multi-purpose products, as touted by colorful pesticide brochures and labels.

As pointed out in Appendix A of this report, the home gardener has no practical way of utilizing Federal, state or other unbiased sources of advice on home and garden pesticides in his choice of products. Public agencies, especially state Agricultural Extension Services, have very useful observations, advice and recommendations available. However, performance results and recommendations of these agencies identify pesticide chemicals by their common names or chemical names instead of brand names. Thus, while there are many alert, well educated and interested suburban homeowners and gardeners and many gardening organizations who are keenly interested in this information, it is extremely difficult, if not impossible, for the layman to relate these recommendations to the home and garden pesticide products offered for sale.

As noted in Appendix A of this report, home and garden pesticide manufacturers want their products identified by brand and product names, instead of by active chemical ingredients. Label description of active ingredients is a legal requirement, but choice of placement and size of print for this label section indicate manufacturers do not expect or encourage their customers to take an interest in it. In many instances, this discouragement of interest by manufacturers is manifested in their choice of using the chemical names of active ingredients instead of the common names, which some customers might be able to identify. For example, DDT was described on the label as "1,1,1-trichloro-2,2-bis (p-chlorophenyl) ethane." This disguise was so effective that not even store owners realized they carried DDT-containing products.

One reason for this subterfuge by home and garden pesticide manufacturers is that they often replace active ingredients in tradenamed products without changing the product name, handling characteristics or outward appearance. From an environmental standpoint, these changes often represent improvements. One manufacturer recently replaced a heavily chlorinated, probably rather persistent herbicide active ingredient which has to be used at 30 - 35 lbs. of active ingredient per acre with a probably much less persistent organic phosphate chemical requiring "only" 10-20 lbs. of active ingredient per acre.

Likewise, many other persistent pesticides previously contained in home and garden formulations have quietly been replaced by less persistent ingredients.

In general, manufacturers of home and garden pesticides are aware they must approach environmental concerns in a different manner from agricultural pesticide manufacturers. Companies selling pesticides for farm use deal with customer attitudes which are somewhat at variance with those of the general population. In contrast, manufacturers of home and garden pesticides deal with the public at large. Their literature and philosophy in the marketing of home and garden pesticides quite clearly reflect this awareness.

Practically all pesticides now in commercial use were developed prior to the "environmental age." In the past, prime concerns governing the development and registration of pesticides were effectiveness at economically feasible dosage rates, safety to the user, and safety to the consumer who might be exposed to residues by way of consuming treated produce. Consequently, safety tests of pesticide chemicals included extensive studies on their acute and chronic toxicity to laboratory animals, and on the nature and the quantities of residues remaining on treated crops or animals after application. Concern about possible effects of pesticides and their residues on the environment is of recent origin, and practical methods of measuring and monitoring such effects, or of screening pesticides for their behavior in this regard have not yet been resolved. Accordingly, manufacturers wishing to develop and offer more environmentally desirable home and garden pesticides presently have very little tangible and authoritative information to follow.

The contractor has reached the following conclusions about alternative methods of controlling lawn and garden pests:

1. Methods such as microbial agents, juvenile

hormone mimics or pest management systems which look very promising for use on some agricultural crops and pests are not likely to be employed in the lawn and garden area in the near future.

2. Organic gardening methods appear to work well in the hands of small, dedicated groups of believers. A well-developed "green thumb" combined with considerable biological knowledge seem to be prerequisites for the success of completely non-chemical gardening.

3. The large majority of suburban gardeners consider "pure" organic gardening methods too cumbersome and time consuming, and do not have the patience and the basic knowledge to make them work.

4. Consequently, the contractor does not foresee suburban gardening without the use of any chemicals as a realistic possibility. There is room for improvement in products and practices presently employed for the control of lawn and garden pests.

5. An overwhelming majority of suburban gardeners are keenly aware of the pesticide problem in relation to the environment. For instance, all are aware of the DDT issue. Suburban gardeners appear to be most receptive to additional information and more practical advice on how to translate these concerns into action. They

need realistic guidance on how to select products and practices which will preserve and enhance the environment and minimize damage to non-target organisms and pollution from pesticide run-off.

6. Manufacturers of home and garden pesticides, especially those operating nation-wide, are aware that their clientele is the public at large and that this market is concerned about the quality of the environment. Their efforts to develop environmentally desirable products are hampered by the present lack of methods and yardsticks by which to measure and monitor the environmental damage potential of chemicals.

7. Federal and state extension specialists and other public officials dealing with lawn and garden pests and their control share the public concern about environmental quality and have developed a great deal of useful information, advice and control recommendations.

8. A major obstacle to more effective communication and cooperation between these three groups - suburban gardeners, home and garden pesticide manufacturers and public agencies - is the area of pesticide nomenclature. Lay gardeners know home and garden pesticide products in terms of brand and trade names, while public agencies refer to pesticide active ingredients in terms of common

or chemical names. Present practices of identifying active ingredients on home and garden pesticide labels make it practically impossible for the lay person to utilize public agency recommendations.

RECOMMENDATIONS

Alternatives to Pesticide Use

1. To make home and garden pesticide labels more meaningful to the user and to facilitate lay persons' understanding of research findings and recommendations by Federal and state agencies, make it mandatory that all active ingredients be identified by common names.

2. Encourage public agencies, gardening organizations and home and garden pesticide manufacturers to cooperate in the development of meaningful, practical information and advice on how to control pests around the house and yard in such a way as to reduce actual and potential environmental harm to a minimum. Furnish suburban gardeners easily understandable, unbiased information on the properties of pesticide active ingredients and on their potential for environmental harm in terms which they can relate to product labels.

3. Develop and furnish to suburban gardeners practical information on the pollution potential of different pesticide use methods. Examples: dry granular lawn insecticides are less liable to produce runoff than liquid sprays; are multi-purpose "convenience" products really necessary?

APPENDIX F

APPLICABLE LAWS AND REGULATIONS

The contractor has endeavored to examine and present in concise form the status of Federal and state laws directly pertinent to the states and three cities. By collecting and analyzing pertinent laws at the state and Federal level, and through a series of interviews with key people, a picture of good and bad has been assembled; each will be presented with the contractor's evaluation of areas of needed reform.

The Appendix is organized as follows: a review of Federal Laws and proposed new legislation; a review and synopsis of state laws affecting each of the ghree cities; a review of local laws or lack of them; and finally a section containing the text of each of these laws and selected pending bills.

Existing Federal Laws

The Federal regulation of pesticides operates under the Federal Insecticide, Fungicide and Rodenticide Act (FIFRA), enacted in 1947 and amended in 1959, 1961, and 1964. The act prohibits the interstate of international shipment of economic poisons unless they are: registered pursuant to provisions of Section 4 of the act, are in unbroken immediate containers, and are labeled according to the provisions of the act.

Should the Administrator find that an imminent hazard to the public would exist, he may suspend the registration of an economic poison immediately. Any person who violates this law may be found guilty of a misdemeanor and on conviction can be fined not more than $1,000.00

New Federal Legislation

During 1971, Congress has considered legislation to amend or replace FIFRA. At least eight different bills dealing with pesticides were introduced in the House of Representatives. The primary one was H.R. 4152. In the Senate, four bills have been under consideration, two of which (S.600 and S.745) would -- like H.R. 4152 -- replace the present FIFRA. The other bills would either prohibit the sale of DDT or prohibit the sale of aldrin, chlordane, DDD/TDE, dieldrin, endrin, helpachlor, lindane, and toxaphene. The fate of any legislation in the Congress is to be considered uncertain until enacted by both Houses and sent to the President. H.R. 10729, the Committee rewrite of H.R. 4152, was enacted by the House in the first session of the 92nd Congress. There is strong expectation that

Senate action in the 1972 session will result in enactment of a new FIFRA very similar to H.R. 10729.

H.R. 10729 incorporates many of the provisions of the existing law (FIFRA), but goes well beyond it in the Federal regulation of intrastate as well as interstate activities, including registration of pesticides in intrastate commerce. It provides for the classification of pesticides as to: (a) "general use" or (b) "restricted use". The original versions has a third category of "use by permit only". It also provides for the certification of pesticide applicators. It provides for aid and guidance to states in developing training programs for pesticide applicators and for the certification of individuals entitled to use restricted pesticides.

The bill also substantially increases the enforcement powers of the Federal agency. There are provisions for criminal misdemeanor and for civil penalties. These include not only the registrant, wholesaler, dealer, retailer, or other distributor, the commercial pesticide applicator, but the farmer who "knowingly violates any provision of the Act."

Impact of the Pending Federal Legislation

The contractor views the pending legislation as (1) an integral part of more effective pollution control which provides for (2) improved control of commercial and private applicators to prevent overdoses and careless applications, (3) more effective handling of pesticides, (4) reduction in on-site storage of pesticides, and (5) more effective control over retail sales subject to recall on order of the Administrator.

City and urban community officials seem to generally concur in this opinion. When contacted, they were, for the most part, helpful and seemingly aware of the necessity to control certain areas of pesticide use. These people felt generally that their offices have tried and were trying to implement programs tending to minimize possible environmental damage. Many felt that some retailers and formulators were using practices designed to circumvent existing regulations and most felt that the pending Federal legislation would be of material help. As might be expected, the greatest opposition came from some retailers and commercial applicators -- both groups saw the impending legislation as too restrictive.

The contractor believes that most commercial structural applicators, including the common household pest applicators are responsible and honestly try through national and local organizations to follow reasonable guidelines. There is, however, a large group of "cut-rate" applicators operating in most major cities around the country who are opportunistic and in many cases require only a merchant's license and a spray can to be in business. Health officials are concerned because these operators do a job which many municipalities cannot do; the reputable applicators are quite vocal in their opposition to this group, feeling that they give the industry a bad name.

Section 20, Research and Monitoring, and Section 23, State Cooperation and Training of H.R. 10729, are particularly significant advances. The provisions which specifically empower the Administrator to (1) foster research in biologically integrated alternatives for pest control, (2) formulate a national plan for monitoring, (3) expand public funds to encourage state programs in training of certified pesticide applicators, are viewed by the contractor as necessary and desirable.

Testing and Registration of New Pesticides

Section 3. Registration of pesticides appears to provide for sufficient information to allow the Administrator to make adequate judgments regarding new compounds. The provisions which allow a full description of tests performed, §3(c)(1)(D), and the results thereof transmitted to the Administrator as he desires and §3(c)(1), wherein the Administrator shall publish guidelines specifying the kinds of information required in support of registration, are regarded as particularly important. The further provision that the Administrator shall make public all scientific information relating to the registration of any particular compound is viewed as an absolute necessity and long overdue (S 23 (c)(2), p.18, lines 4-9).

State Law Summary

Texas. The Texas Economic Pesticide Law of 1971 is simple and direct. Although it does make provisions for the establishment of an Advisory Committee, it is felt that additional members should be added to make more equitable decisions possible. Apparently part of the burden of determining whether certain pesticides possess "serious uncontrollable adverse effects" or are "of greater detriment to the environment" than "the benefits received by its use" etc. will fall on this committee.

Authority is still vested in county commissioner courts to ameliorate portions of the state herbicide law which is a kind of use and application provision. Such authority may be subject to abuses in certain cases. No insecticide use and application provisions are currently in force. Most of the bills which were offered but which did not pass in 1971 were really too broad and under the existing law would have been difficult to interpret in individual cases.

The synopsis which follows shows provisions of laws enacted in 1971 as well as the first mentioned bills which failed to become law this year. The distribution of more stringent commercial applicator laws or a restricted use provision encompassing chlorinated hydrocarbons would have been desirable but were not passed. Texas was a large user of raw DDT which was formulated for use in the state. The recent ban on interstate shipments of DDT will materially affect this use.

SYNOPSIS OF TEXAS LAWS

Bills Enacted:

Title	Senate Bill 602 (House Bill 1338) [amends Insecticide Law]
Prohibited acts	Forbids sale to purchasers other than those named on custom mixes; Prohibits registration of pesticides with "serious uncontrollable adverse effects," or whose use is "of less public value" or "of greater detriment to the environment" than "the benefits received by its use," or which "is detrimental to vegetation, to domestic animals, or to the public health and safety."
Authority granted to:	
restrict usage	requires ingredient statement and purchaser's name on custom mixes; stop sale provisions.
require compliance label	batch numbers or symbols on labels.
inspect property	factory inspection.
Pesticide Board	Advisory Committee composed of Texas A&M and Texas Tech deans, and heads of departments of Parks and Wildlife, Health and Agriculture.
Title	Senate Bill 910 Enacts Structural Pest Control Law titled, "Texas Structural Pest Control Act."
Authority granted to:	Create a structural pest control board.
licensing	Yes.
regulation of persons engaged in business	Yes.

Title	House Bill 217
Grants authority to:	County commissioner courts, to exempt, revoke exemptions and reinstate exemptions of counties from the provisions of the law governing sale, use and transportation of herbicides where it relates to custom applicators.
Relevant Laws	Texas Herbicide Law [Tex. Rev. Civ. Stat. (1969), art. 135b-4] This act regulates the sale, use, and transportation of herbicides and requires commercial applicators (those who apply herbicides to more than 10 acres per year) to obtain a permit, and those who sell herbicides in amounts over 1 pound (except up to 1 gallon of 10% concentrate for lawn use) to be licensed by the Department of Agriculture. Equipment used in custom application must also be inspected and licensed. The law and regulations are very specific, but certain counties are exempted from all provisions of the law and others are exempted from some provisions of the law. "Insecticide, Fungicide, and Rodenticide Act of Texas" [Tex. Rev. Civ. Stat. (1971), art. 135b-5]

Bills Not Passed

Title	House Bill 9. Changes name of Insecticide, Fungicide and Rodenticide Act to Economic Pesticides Control Act and amends it.
Prohibited Acts	Prohibits registration of pesticides which have "uncontrollable adverse effects," or whose use is "of less public value" or "of greater detriment to the environment" than "the benefit received by its use," or for which there is a substitute "less destructive to the environment" or which "is detrimental to vegetation, animals or public health and safety" or which "is of little or no value."
Authority granted to:	
restrict usage	Yes; permit provision.
Title	House Bill 55
Prohibited acts	Bans sale or use of DDT.
Title	House Bill 671 Enacts commercial applicators law.
Title	House Bill 698 (same as Senate Bill 171)
Authority Granted to:	
regulate use	Yes.
regulate storage, transportation and disposal of pesticides	Yes.
Title	House Bill 773
Authority granted to:	

require compliance label	Yes; labels should bear directions for disposal of unused pesticides and decontamination of used containers.
Title	House Bill 795
Prohibited Acts	Bans use of pesticides which are not biodegradable [biodegradable is defined as "capable of being broken down into its chemical components by processes of nature."]
Title	House Bill 1603
Authority granted to:	
issue regulations	Yes.
Pesticide Board:	Water Quality Board with the concurrence of the Commissioner of Agriculture and the Departments of Health, Education and Welfare.
Title:	Senate Bill 170 (House Bill 321)
Prohibited Acts	Bans the sale of chlorinated hydrocarbon pesticides.
Title:	Senate Bill 171
Authority granted to:	
issue regulations:	Yes.
regulate storage, transportation and disposal of pesticides:	Yes.
Pesticide Board:	Pesticide Control Agency, headed by Pesticide Control Administrator.
Title:	Senate Bill 234 (House Bill 321)
Prohibited Acts:	Bans sale of DDT "and of any other chlorinated hydrocarbons" and any other product sprayed or treated by them.

Pennsylvania. This state's existing law is fashioned generally after FIFRA. No restricted use clause or use or application law is included. The fate of many of the pending bills is in doubt. Generally speaking, the offered bills were much more restrictive than existing law. Restricted use provisions, the prohibition of chlorinated hydrocarbon pesticides, except in emergency, are received as desirable. This state will probably find it easy to accept the pending Federal legislation.

Of particular noteworthiness is Senate Bill 668 which would grant authority to the Department of Environmental Resources to establish centers to collect and dispose of non-biodegradable pesticides. This is the first law the contractor team has learned of which addresses the problem of eliminating contamination from "empty" pesticide containers. The following synopsis of laws shows provisions of this and other pending pesticide legislation.

SYNOPSIS OF PENNSYLVANIA LAWS

Title	No pesticide use and application law.
Relevant laws	"Pennsylvania Pesticide Act of 1957" (Economic poison law) (Pa. Stat. Ann. (1963), tit. 3, s 111.1 to 111.12) "Pennsylvania Grape Herbicide Act" (1965) (Pa. Stat. Ann. (1963), tit. 3, s 214.51 to 214.55) Permits establishment of geographical areas, within which use of herbicides may be restricted or prohibited. Pest Control Compact (1967) (Pa. Stat. Ann. (1963), tit. 3, s 214.41 to 214.47) Provides for the entry of the Commonwealth into a compact with other States relating to pest control.

Bills Enacted: None
Bills Pending:

Title	House Bill 447
Prohibited acts	Bans sale of pesticide containing additive to mask or change its odor. Amended to prohibit sale of a pesticide containing additive "for the purpose of adding an odor where there is none, unless the additive, because of its objectionable nature, tends to limit or lessen the use of such pesticides."
Title	House Bill 807
Licensing	Every manufacturing or processing plant within the commonwealth to register every chemical and mineral used - manufacturing or processing if such chemicals will be discharged into waters or sewage system.
Title	House Bill 819
Prohibited acts	Prohibits sale, use or distribution of DDT (including isometric compounds), endrin, chlordane, aldrin, dieldrin, lindane, heptachlor, or toxaphene or any of their isomers, except in an emergency.
Title	House Bill 1016 Amends Pennsylvania Pesticide Act
Licensing	
fees	fee based on volume of sale for dealers in restricted use pesticides; others - annual fee $3.00. Secretary may review and revise

	fees. Non-fee license required of farmers or landscape gardeners to use restricted use pesticides.
Definitions	pesticides - include spray adjuvants. restricted use pesticides - highly toxic, persistent or permanent pesticides which the Secretary finds to be so hazardous to man or his environment, animal, wildlife, livestock, poultry, or crop, except pest or vegetation to be destroyed, that restriction on its sale or use is necessary to protect the public.
Labeling	for pesticides containing mercury.
Pesticide Board	Ten-member council
Title	House Bill 1557
Prohibited acts	Prohibited pesticides include DDT, endrin, benzene hexachloride, chlordane, aldrin, dieldrin, lindane, heptachlor, toxaphene, and any of their isomers.
Licensing	
qualifications	permit system similar to that in New York.
fees	None.
Authority granted to	
restrict usage	Secretary of Environmental Resources would establish list of restricted pesticides.
Title	Senate Bill 668
Authority granted to	Department of Environmental Resources to establish centers to collect and dispose of non-biodegradable pesticides.
Title	Senate Bill 1036

Appropriations	$665,000 to Department of Environmental Resources to establish a forest insect biological control program.

Michigan. Michigan already has adequate provisions for testing and licensing of applicators. Annual review and renewable clauses are deemed desirable.

The Pesticide Advisory Board in this state (cf. Texas) is constituted of members more directly concerned (and knowledgable) about environmental contamination and potential health hazard to humans. Additional licensing provisions and the inclusion of restricted use categories in legislation passed in 1971 are seen as desirable additions to the law. This state will have no problem with the Administration Bill (H.R. 10729) since many of their provisions are already more restrictive than the proposed Federal law. The provisions of the existing law do not, however, specify restricted use pesticides, it merely grants the authority to the Department of Agriculture to designate such.

A public hearing was scheduled for December 9, 1971, on Michigan's Department of Agriculture proposed Regulation No. 633. This proposed regulation provided for the identity of restricted use pesticides and their formulations; who may sell them and for what purposes; as well as licensing and examination and reporting of sales provisions for such compounds. Such a regulation, with the full support of the Department of Agriculture, is seen as very worthwhile legislation.

Other Michigan laws and pending legislation about pesticides are outlined in the synopsis which follows.

Title	Application of Economic Poisons [Mich. St. Ann. (1967), s 12.353]
Prohibited acts	Unlawful to operate pesticide equipment or apply pesticides commercially unless licensed by the Director of Agriculture.
Exemptions	Farmers, municipalities, road commissions, or State or Federal agencies.
Licensing	
qualifications	Director must find applicant qualified.
application	Forms to be furnished by Director.
examination	Examination of application form required.
fees	Initial license $20; annual renewal $20.
issuance	Issued after applicant found qualified; renewable annually (December 31).
nonresidents	No provision for reciprocity.
Financial responsibility	Applicant with unsatisfied judgments required to post bond before obtaining license.
Authority granted to:	
issue regulations	Yes.
enforce the act	Yes.
delegate duties	Yes.
restrict usage	Yes.

inspect property	Yes.
require records	Not specified in act.
cooperate with others	Not specified in act.
publish information	Not specified in act.
conduct courses	Not specified in act.
regulate storage, transportation, or disposal of pesticides	Not specified in act.
require compliance with label	Not specified in act.
license equipment	Not specified in act.
subpoena persons or records	Not specified in act.
report losses	Not specified in act.
investigate damages	Not specified in act.
Pesticide board	Five-member advisory committee created consisting of Director of Conservation, Director of Public Health, Director of Aeronautics, Director of the Pesticides Research Center, Michigan State University, and the Executive Secretary of the Water Resources Commission (or their designee).
Definitions	1. aircraft 2. defoliant 3. desiccant 4. Director 5. economic poison 10. herbicide 11. insect 12. insecticide 13. nematocide 14. nematode

6. equipment
7. fungi
8. fungicide
9. ground equipment
15. person
16. plant regulator
17. weed

Penalties	Violation of act or regulation is a misdemeanor
Relevant laws	"Michigan Insecticide, Fungicide, and Rodenticide Act of 1949" [Mich. St. Ann. (1967), s 12.352]
	Michigan 2,4-D Act [Mich. St. Ann. (1967), s 12.366] Permits establishment of designated areas within which the use of certain herbicides may be prohibited (grape vineyards).
	"Michigan Food Law of 1968" [Mich. St. Ann. (1967), s 12.933] Sec. 12.933(21) provides that any pesticide chemical in or on a raw agricultural commodity is unsafe, unless in compliance with the Federal Food, Drug, and Cosmetic Act.

LAWS PASSED IN 1971

Title	Amendment to the Michigan "Insecticide, Fungicide and Rodenticide Act of 1949."
Additions	Adds and defines the following terms: 1. Restricted use pesticides 2. Restricted use pesticide dealers 3. Identity of restricted use pesticide formulations to be sold only by licensed dealers. 4. Identity of those restricted use formulations that may be sold by licensed dealers only to licensed economic poison applicators or representatives of governmental agencies.
Authority granted to:	Authorize the Director of the State Department of Agriculture to adopt a list of restricted use pesticides and to regulate the ". . . time and conditions of sale, distribution and use of restricted use pesticides. . ." Require dealers to furnish the Director of Agriculture a ". . . record of all sales of restricted use pesticides. . ." and to keep copies of such records for a period of 2 years. Other State agencies may obtain copies upon request [with certain exceptions relating to patent rights].
restrict usage	Yes.
require records	Yes.
reports of sales	Yes.
require licensed dealers to supply information to purchaser	Yes.

Licensing

qualifications and application	A person in charge of each sales location or outlet shall apply, on a form prescribed by the Director for a license to sell restricted use pesticide formulations for each location or outlet.
examination	Person applying shall pass a written examination.
issuance	Issued after applicant found qualified; renewable annually on or before January 1 of each year.
nonresidents	No provision for reciprocity.

Comments upon House Bill No. 4775, approved August 12, 1971 amending the Michigan "Insecticide, Fungicide, and Rodenticide Act of 1949"

At the present time, 30 states either restrict or have the authority to restrict the sale and use of certain designated pesticides. Nineteen of these states (Arizona, Colorado, Delaware, Florida, Idaho, Indiana, Maryland, Michigan, Minnesota, Montana, Nevada, New Hampshire, New York, North Carolina, North Dakota, Ohio, Oregon, Utah, and Washington) have incorporated and defined the term "restricted use pesticides" in their laws.

The other 11 states (see list below) use terms having essentially the same meaning or include authority (enabling legislation) for some state agency to prohibit, restrict, or otherwise control the use of designated pesticides through the issuance of regulations.

> Alaska, California (restricted materials or injurious materials), Connecticut (prescribed or prohibit use), Hawaii (herbicides only), Illinois, Maine (relating to waters), Massachusetts (hard, persistent pesticides), New Jersey, New Mexico (environmentally harmful, persistent pesticides), Rhode Island (banned or restricted pesticides, and Wisconsin.

BILLS PROPOSED BUT NOT PASSED IN 1971

House Bill 4683 - Prohibits sale of pesticide/fertilizer mixtures.

House Bill 4706 - Directs Department of Agriculture not to register heptachlor, dieldrin, toxaphene, lindane, benzene hexachloride, endrin, aldrin and chlorade except where the agricultural experiment station says there is no reasonable alternative.

House Bill 4707 - Makes it a misdemeanor to use a pesticide which is not registered.

House Bill 5486 - Would prohibit sale of product packaged in polyvinyl chloride containers or the use of such containers after December 31, 1972.

Identity of Favorable Types of Laws

Although some states presently have laws which appear to control use and application, it is seen that sufficient control is not observed in practice at all times. Hopefully, the provisions of the bill, which would strengthen or reinforce Federal aid to educational programs designed to improve methods of application and human safety, would have their impact in increased environmental protection as well.

Some of the verbiage of the existing state laws is rather loose in the interpretation of how to dispose of containers and unused pesticides. Hopefully this major source of environmental contamination will be solved by more useful state laws in the future. As indicated in another section of this report, many householders have expressed an earnest desire to dispose of their material in a suitable way, but do not know of a practical solution. Aid in this matter should come from all states as soon as possible. (See Pennsylvania Senate Bill 668.)

Studies on various soil types indicate that considerable residues exist in urban and suburban soils around the country. Means of identifying this residue level would be desirable. To date, not enough is known to conduct a mass balance to see where the pesticides go once they are applied. Legislation providing for studies of this type would help increase our overall understanding of pesticide use and degradation patterns.

The activities of State Departments of Agriculture through the Agricultural Extension Service are well known to farmers. The activities of this group as well as the valuable services and information they provide are much less well known to suburban and urban home gardeners. Provisions of the proposed Federal legislation which would augment educational programs in the various states is viewed as a very desirable feature and one which would materially aid this heavy pesticide use group.

The strengthening of applicator laws is viewed as another very desirable feature of some state laws. However, responsible operators who perform valuable services should not suffer from over-regulation.

Local Pesticide Laws and Regulations

As part of the survey of the three study cities, the contractor contacted all the municipalities which make up the suburban areas under study. These are spread out over five counties in Pennsylvania, three in Michigan, and one in Texas. The possibility of county laws or regulations as well as township laws concerning use or sales of pesticides was explored. In the entire study area only one local law was found. This is an ordinance of the City of Grand Prairie, Texas, requiring the licensing of all commercial applicators. This ordinance requires the applicant to carry personal property and injury insurance and a performance bond, and that he apply for a license each year. The applicant is not required, however, to show practical or theoretical knowledge of pesticides, and the pests each controls. This law is a start in the right direction, however. In many cities, all that is needed to be a pesticide applicator is a merchant's license and some pesticide. The licensing of an operator and the requirement of financial responsibility should tend to make the applicator more careful in his work. The title section of this ordinance follows, the full text is reproduced in the text of laws sections of this Appendix.

> Ordinance No. 1498. "An ordinance to license and regulate pest control operators in the City of Grand Prairie; making it unlawful to engage in the business of pest control without obraining a license from the City of Grand Prairie; establishing requirements for obtaining a pest control operator's license; providing for payment of a license fee; excepting certain persons or firms from the operation hereof; providing for the revocation of such license, and for an appeal from such revocation; providing that pest control operators in the City shall comply with this ordinance within sixty (60) days from its enacement; providing a penalty for violation hereof; declaring the provisions contained herein to be severable; providing for publication; and providing that this ordinance shall take effect from and after five (5) days after such publication."

Tables 1-F, 2-F and 3-F show the response from each of the municipalities contacted in the study cities. Except for Grand Prairie, the tables show no local attempts to control or limit pesticide use. In a few cities outside the study area, local laws restricting the use of DDT have been discovered. It is possible that local governments do not feel they have sufficient knowledge to restrict pesticide use or it may be that a reliance on state and Federal laws seems sufficient because of a lack of visible problems concerning pesticides.

Vector control officers, environmental health officers and Agriculture Department officials were contacted as part of the program to assess the local control of pesticides. The contractor found only that insect fogging programs and rodent control programs may either be well planned or operated haphazardly, without record keeping or listing of complaints received.

At the local level, pesticide control is not practiced in these study cities. Attempts were made to see if this was a unique situation or a widespread phenomena by contacting similar officials in other mid-Atlantic cities, but no evidence of other programs was discovered.

TABLE 1-F

LAW QUESTIONNAIRE SUMMARY REPLIES: DALLAS, TEXAS SUBURBS

Municipality	Pesticide law?	Retailer's license?	Applicator's license?	Applicator's course?	Products registered?	Pesticides restricted?	Pesticides prohibited?	Comments
Dallas, Tex.	None	None	None; the State of Tex. is currently setting up a board to regulate chemical applications throughout the state.	None	None	None	None	Read the label. Understand the instructions. Follow manufacturer's direction for use.
Univ. Park	None	None	None	None	None	None	None	None
Grand Prairie	Yes	Yes	Yes	No: Senate Bill 910,62nd Legislature, Regular Session, 1971 for 1972 & beyond.	No	No	No	None
Duncanville	None	None	None	None	None	None	None	In our community we actually have experienced only one local problem parathion use & its control. As we have grown from a rural to a suburban community, this has not been a significant problem.

TABLE 1-F
Continued

Municipality	Pesticide law?	Retailer's license?	Applicator's license?	Applicator's course?	Products registered?	Pesticides restricted?	Pesticides prohibited?	Comments
Seagoville	None	None	None	None	None	None	None	It is possible that we need some control over the uses of pesticides, but at this time we have none.
Irving	No, certain prohibitive ordinances	The same as any other retail merchant	If they go from door to door they must have a solicitor's license	None	The Federal legend law is applicable	None; other than those that would appear on the Government Control sheet	We would not permit or omit anything beyond government restriction	In Vector Control this city has for the past several years used BHC Dust in dusting applicators and Batex in liquid applicators as a control agent. The standard used in selecting these two is based upon the fact that they are nontoxic to humans and toxic to insects. Admittedly, there are products on the market that have a greater knock down power but the selection of these could have

TABLE 1-F
Continued

Municipality	Pesticide law?	Retailer's license?	Applicator's license?	Applicator's course?	Products registered?	Pesticides restricted?	Pesticides prohibited?	Comments
								an adverse effect on the local residents.
Sunnyvale	None	None	None	None	None	None	None	We have no ordinance but feel that the control of pesticides usage is important.
Richardson	None	None	None	None	None	None	None	Overplayed.
Rowlett	No	Yes						We are a small city and at the present do not have a health officer.

TABLE 2-F

LAW QUESTIONNAIRE SUMMARY REPLIES: LANSING, MICHIGAN

Municipality	Pesticide law?	Retailer's license?	Applicator's license?	Applicator's course?	Products registered?	Pesticides restricted?	Pesticides prohibited?	Comments
Delhi Township	None	None	None	None	None	Only through State regulations	None	None
Lansing Township	None	None	None	None	None	Only through State regulations	No DDT used now using malathion	At Michigan State Univ. there is an interior fight between the students and environmentalists and the professors who developed pesticides. There is a wishy-washy situation right now, which the state should settle.
Meridian Township	None	None	No-not by local law, by state law	None	None	DDT is restricted state-wide 2,4,5-T is somewhat restricted	DDT by state law only, malathion & larvicide use more wide now because there are no residual effects	None

TABLE 2-F
Continued

Municipality	Pesticide law?	Retailer's license?	Applicator's license?	Applicator's course?	Products registered?	Pesticides restricted?	Pesticides prohibited?	Comments
City of East Lansing	None	Not from local gov't.	None	None	None	Not through local ordinance. DDT restricted, malathion now used.	None	This is a subject for Federal or State control
Ingham County Lansing, Mich	None	None New state law for '72	None	None	Yes, rodenticides	Yes, DDT	Yes, 1080 or sodium fluoroacetate is tightly regulated	Problem probably over played, but there is potential hazard.

TABLE 3-F

LAW QUESTIONNAIRE SUMMARY REPLIES: PHILADELPHIA, PENNSYLVANIA SUBURBS

Municipality	Pesticide law?	Retailer's license?	Applicator's license?	Applicator's course?	Products registered?	Pesticides restricted?	Pesticides prohibited?	Comments
Philadelphia	No	No	No	No	No	No	No	It is my opinion that pesticides have created no environmental hazard in terms of measurable human mortality. Uncontrolled application of pesticides may become a threat but I feel the risk has been overstated. I favor a management approach rather than banning them outright. Licensing through training and examination of pesticide commercial applications and sale and use also most desirable.
Doylestown Bucks County	No	No	Nc	No	No	No	No	None

TABLE 3-F
Continued

Municipality	Pesticide law?	Retailer's license?	Applicator's license?	Applicator's course?	Products registered?	Pesticides restricted?	Pesticides prohibited?	Comments
Chester County	No	No	No	No	No	No	No	Chester County has no regulations in this field at present. None is contemplated at present time.
Moylan	No	No	No	No	No	No	No	None
Upper Darby	No	No	No	No	No	No	No	Improper use of pesticides naturally can be a hazard. However, certain environmental damage must be tolerated at times. The trade off of damage versus total effective control of insect and rodent vectors must be weighed and decided on the merits of each case.

TABLE 3-F
Continued

Municipality	Pesticide law?	Retailer's license?	Applicator's license?	Applicator's course?	Products registered?	Pesticides restricted?	Pesticides prohibited?	Comments.
Media	No	No	No	No	No	No	No	None
Edgmont	No	No	No	No	No	No	No	Spraying by County Weed Control Unit does not seem to appreciably reduce weeds along roadsides but does produce an appearance of blight.
Haverford	No	No	No	No	No	No	No	None
Lansdowne Township	No	No	No	No	No	No	No	Not qualified to answer.
Tinicum Township	No	No	No	No	No	No	Use only those approved by government. We have no laws prohibiting pesticides.	The township does not have an Environmental Health office or Vector Control officer. The township does have a Health officer who works in conjunction with the Tinicum Township Board of Health.

TABLE 3-F
Continued

Municipality	Pesticide law?	Retailer's license?	Applicator's license?	Applicator's course?	Products registered?	Pesticides restricted?	Pesticides prohibited?	Comments
Lower Southampton	No	No	No	No	No	No	No	Kindly refer to the Bucks County Department of Health, Doylestown, Pa.
Abington	No	No	No	No	No	No	No	The controls of the ingredients used in the manufacture of pesticides that are available for purchase by the general public are a matter for "higher government" (state or Federal) legislation. At the local level we do not have any facilities or staff to make a scientific study. Local government does not have the legal authority to legislate for or control areas or sources outside its jurisdiction.

TABLE 3-F
Continued

Municipality	Pesticide law?	Retailer's license?	Applicator's license?	Applicator's course?	Products registered?	Pesticides restricted?	Pesticides prohibited?	Comments
Malvern Borough	No	No	No	No	No	No	No	Only pesticides that are degradable within a relatively short time span should be permitted. The long range public health and environmental hazards have not really been determined as yet. I do not feel that the danger is overplayed. Pesticides are perhaps a greater pollutant than either sewage or solid waste.
Cheltenham	No	No	No; state legislation proposed	Not locally. Recommended by state.	No	No	No	See following page.

TABLE 3-F
Concluded

Cheltenham Comments

The degree to which pesticides adversely affect the health of the public remains unclear to both the professional public health worker and to the public in general. It is generally agreed that some pesticides are necessary to protect agricultural products, livestock, and humans. It is also agreed that some pesticides may be potentially harmful to humans, however, unsafe tolerances and just what may constitute "improper use" of these still needs to be clearly defined.

Some "conservationists" and "ecologists" are ready to completely ban DDT although its toxicity to humans apparently has not been established. The enclosed article extracted from U. S. Medicine, March 1, 1971 presents an interesting point of view. A specimen of "helpful hints" distributed by a local group interested in environmental control is also enclosed.

Until reliable data is developed upon which sound conclusions can be based, and there is some element of agreement on these, it is my opinion that local laws, codes, or ordinances (below State level) are not warranted at this time since they would tend only to add to the existing confusion. Undoubtedly, there is a need for some control and limitation of pesticides - the question remains as to the degree.

Recommendations

1. Since over eighty percent (80%) of the total pesticide load applied in homes and gardens is applied directly by the homeowner, it is apparent that this group needs to have as much or more control exercised over them as do commercial applicators or farmers. By and large, this group of people are extremely naive about the compounds they apply. They appear to rely on promotional criteria and salesmanship, rather than the actual product required for a specific job. One form of restraint would obviously be in what is available to them. This group should have free, unbiased recommendations for use and application, as well as means of disposal. Federal support of educational programs is anticipated.

2. The use of some persistent compounds appears warranted where it can be clearly demonstrated that possible contamination of the environment is highly unlikely. Structural pest applications where the material can be worked down or otherwise prevented from vaporization or runoff are suggested. The further use of more persistent compounds may be justified when the preservation of a valuable crop (a seldom occurrence in the home and garden use of pesticides) is confronted with an extreme emergency.

3. The careless and reckless "dollar-a-room" pesticide applicator obviously needs some restraint placed on his activities. Licensing, which includes examinations or testing for knowledge, the posting of an adequate bond and other controls supported by a rigid enforcement program are desired.

4. Passage of the Administration Bill (H. R. 10729) as well as full state and Federal implementation of its provisions is urged. Although directed primarily at agricultural activities, its content clearly would have a profound influence on suburban and urban pesticide use.

5. Interdisciplinary research and down-to-earth thinking will have to be combined to answer many of the questions outlined above. Industrial and independent research and consulting organizations have much experience, and have had much success in practical, problem-solving research. This type of experience is greatly needed in this complex area of environmental research and should therefore be engaged to the maximum extent possible, along with other appropriate research sources.

TEXT OF LAWS

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FEDERAL LAWS

FEDERAL INSECTICIDE, FUNGICIDE, AND RODENTICIDE ACT

(7 U.S.C. 135-135k)

Approved June 25, 1947 (61 Stat. 163) as amended by the Nematocide, Plant Regulator, Defoliant, and Desiccant Amendment of 1959 (73 Stat. 286) as amended by the Act of March 29, 1961 (75 Stat. 18) and the Act of April 7, 1961 (75 Stat. 42) and the Act of May 12, 1964 (P.L. 88-305, 78 Stat. 190)

An Act to regulate the marketing of economic poisons and devices, and for other purposes

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled.

Title

Sec. 1. This Act may be cited as the "Federal Insecticide, Fungicide, and Rodenticide Act."

Definitions

Sec. 2 For the purposes of this Act–

a. The term "economic poison" means (1) any substance or mixtures of substances intended for preventing, destroying, repelling, or mitigating any insects, rodents, nematodes, fungi, weeds, and other forms of plant or animal life or viruses, except viruses on or in living man or other animals, which the Secretary shall declare to be a pest, and (2) any substance or mixture of substances intended for use as a plant regulator, defoliant or desiccant.

b. The term "device" means any instrument or contrivance intended for trapping, destroying, repelling, or mitigating insects or rodents or destroying, repelling, or mitigating fungi, nematodes, or such other pests as may be designated by the Secretary, but not including equipment used for the application of economic poisons when sold separately therefrom.

c. The term "insecticide" means any substance or mixture of substances intended for preventing, destroying, repelling or mitigating any insects which may be present in any environment whatsoever.

d. The term "fungicide" means any substance or mixture of substances intended for preventing, destroying, repelling, or mitigating any fungi.

e. The term "rodenticide" means any substance or mixture of substances intended for preventing, destroying, repelling, or mitigating rodents or any other vertebrate animal which the Secretary shall declare to be a pest.

f. The term "herbicide" means any substance or mixture of substances intended for preventing, destroying, repelling, or mitigating any weed.

g. The term "Nematocide" means any substance or mixture of substances intended for preventing, destroying, repelling, or mitigating nematodes.

h. The term "plant regulator" means any substance or mixture of substances intended through physiological action, for accelerating or retarding the rate of growth or rate of maturation, or for otherwise altering the behavior of ornamental or crop plants or the produce thereof, but shall not include substances to the extent that they are intended as plant nutrients, trace elements, nutritional chemicals, plant inoculants, and soil amendments.

i. The term "defoliant" means any substance or mixture of substances intended for causing the leaves or foliage to drop from a plant, with or without causing abscission.

j The term "desiccant" means any substance or mixture of substances intended for artificially accelerating the drying of plant tissue.

k. The term "nematode" means invertebrate animals of the phylum nemathelminthes and class nematoda, that is, unsegmented round worms with elongated, fusiform, or saclike bodies covered with cuticle, and inhabiting soil, water, plants or plant parts; may also be called nemas or eelworms.

l. The term "weed" means any plant which grows where not wanted.

m. The term "insect" means any of the numerous small invertebrate animals generally having the body more or less obviously segmented, for the most part belonging to the class insecta, comprising six-legged, usually winged forms, as, for example, beetles, bugs, bees, flies, and to other allied classes of arthropods whose members are wingless and usually have more than six legs, as, for example, spiders, mites, ticks, centipedes, and wood lice.

n. The term "fungi" means all non-chlorophyll-bearing thallophytes (that is, all non-chlorophyll-bearing plants of a lower order than mosses and liverworts) as, for example, rusts, smuts, mildews, molds, yeasts, and bacteria, except those on or in living man or other animals.

o. The term "ingredient statement" means either–

(1) a statement of the name and percentage of each active ingredient, together with the total percentage of the inert ingredients, in the economic poison; or

(2) a statement of the name of each active ingredient, together with the name of each and total percentage of the inert ingredients, if any there be, in the economic poison (except option 1 shall apply if the preparation is highly toxic to man, determined as provided in section 6 of this Act); and, in addition to (1) or (2) in case the economic poison contains arsenic in any form, a statement of the percentages

of total and water soluble arsenic, each calculated as elemental arsenic.

p. The term "active ingredient" means–

(1) in the case of an economic poison other than a plant regulator, defoliant or desiccant, an ingredient which will prevent, destroy, repel, or mitigate insects, nematodes, fungi, rodents, weeds, or other pests:

(2) in the case of a plant regulator, an ingredient which, through physiological action, will accelerate or retard the rate of growth or rate of maturation or otherwise alter the behavior or ornamental or crop plants of the produce thereof:

(3) in the case of a defoliant, an ingredient which will cause the leaves or foliage to drop from a plant;

(4) in the case of a desiccant, an ingredient which will artificially accelerate the drying of plant tissue.

q. The term "inert ingredient" means an ingredient which is not active.

r. The term "antidote" means a practical immediate treatment in case of poisoning and includes first-aid treatment.

s. The term "person" means any individual, partnership, association, corporation or any organized group of persons whether incorporated or not.

t. The term "Territory" means any Territory or possession of the United States, excluding the Canal Zone.

u. The term "Secretary" means the Secretary of Agriculture.

v. The term "registrant" means the person registering any economic poison pursuant to the provisions of this Act.

w. The term "label" means the written, printed, or graphic matter on, or attached to, the economic poison or device or the immediate container thereof, and the outside container or wrapper of the retail package, if any there be, of the economic poison or device.

x. The term "labeling" means all labels and other written, printed, or graphic matter -

(1) upon the economic poison or device of any of its containers or wrappers;

(2) accompanying the economic poison or device at any time;

(3) to which reference is made on the label or in literature accompanying the economic poison or device, except to current official publications of the United States Department of Agriculture and Interior, the United States Public Health Service, State experiment stations, State agricultural colleges, and other similar Federal or State institutions or agencies authorized by law to conduct research in the field of economic poisons.

y. The term "adulterated" shall apply to any economic poison if its strength or purity falls below the professed standard of quality as expressed on its labeling or under which it is sold, or if any substance has been substituted wholly or in part for the article, or if any valuable constituent of the article has been wholly or in part abstracted.

z. The term "misbranded" shall apply–

(1) to any economic poison or device if its labeling bears any statement, design, or graphic representation relative thereto or to its ingredients which is false or misleading in any particular;

(2) to any economic poison–

(a) if it is an imitation of or is offered for sale under the name of another economic poison;

(b) if its labeling bears any reference to registration under this Act other than the registration number assigned to the economic poison;

(c) if the labeling accompanying it does not contain directions for use which are necessary and if complied with adequate for the protection of the public;

(d) if the label does not contain a warning or caution statement which may be necessary and if complied with adequate to prevent injury to living man and other vertebrate animals, vegetation, and useful invertebrate animals;

(e) if the label does not bear an ingredient statement on that part of the immediate container and on the outside container or wrapper, if there be one, through which the ingredient statement on the immediate container cannot be clearly read, of the retail package which is presented or displayed under customary conditions of purchase: Provided That the Secretary may permit the ingredient statement to appear prominently on some other part of the container, if the size or form of the container makes it impracticable to place it on the part of the retail package which is presented or displayed under customary conditions of purchase;

(f) if any word, statement, or other information required by or under authority of this Act to appear on the label or labeling is not prominently placed thereon with such conspicuousness (as compared with other words, statements, designs, or graphic matter in the labeling) and in such terms as to render it likely to be read and understood by the ordinary individual under customary conditions or purchase and use;

(g) if in the case of insecticide, nematocide, fungicide, or herbicide when used as directed or in accordance with commonly recognized practice it shall be injurious to living man or other vertebrate animals, or vegetation, except weeds, to which it is applied, or to the person applying such economic poison; or

(h) if in the case of a plant regulator, defoliant, or desiccant when used as directed it shall be injurious to living man or other vertebrate animals, or vegetation to which it is applied, or to the person applying such economic poison: Provided, That physical or physiological effects on plants or parts thereof shall not be deemed to be injury, when this is the purpose for which the plant regulator, defoliant, or desiccant was applied, in accordance with the label claims and recommendations.

Prohibited Acts

Sec. 3. a. It shall be unlawful for any person to distribute, sell, or offer for sale in any Territory or in the District of Columbia, or to ship or deliver for shipment from any State, Territory, or the District of Columbia to any other State, Territory, or the District of Columbia, or to any foreign country, or to receive in any State, Territory, or the District of Columbia from any other State, Territory, or the District of Columbia, or foreign country, and having so received, deliver or offer to deliver in the original unbroken package to any other person, any of the following:

(1) Any economic poison which is not registered pursuant to the provisions of section 4 of this Act, or any economic poison if any of the claims made for it or any of the directions for its use differ in substance from the representations made in connection with its registration, or if the composition of an economic poison differs from its composition as represented in connection with its registration: Provided, That in the discretion of the Secretary, a change in the labeling or formula of an economic poison may be made within a registration period without requiring reregistration of the product.

(2) Any economic poison unless it is in the registrant's or the manufacturer's unbroken immediate container, and there is affixed to such container, and to the outside container or wrapper of the retail package, if there be one, through which the required information on the immediate container cannot be clearly read, a label bearing–

(a) the name and address of the manufacturer, registrant, or person for whom manufactured;

(b) the name, brand, or trade-mark under which said article is sold;

(c) the net weight or measure of the content: Provided, That the Secretary may permit reasonable variations; and

(d) when required by regulation of the Secretary to effectuate the purposes of this Act, the registration number assigned to the article under this Act.

(3) Any economic poison which contains any substance or substances in quantities highly toxic to man, determined as provided in section 6 of this Act, unless the label bear, in addition to any other matter required by this Act–

(a) the skull and crossbones;

(b) the word "poison" prominently (IN RED) on a background of distinctly contrasting color; and

(c) a statement of an antidote of the economic poison.

(4) The economic poisons commonly known as standard lead arsenate, baisc lead arsenate, calcium arsenate, magnesium arsenate, zinc arsenate, zinc arsenite, sodium fluoride, sodium fluosilicate, and barium fluosilicate unless they have been distinctly colored or discolored as provided by regulations issued in accordance with this Act, or any other white powder economic poison which the Secretary, after investigation of and after public hearing on the necessity for such action for the protection of the public health and the feasibility of such coloration or discoloration, shall, by regulation, require to be distinctly colored or discolored, unless it has been so colored or discolored: Provided, That the Secretary may exempt any economic poison to the extent that it is intended for a particular use or uses from the coloring or discoloring required or authorized by this section if he determines that such coloring or discoloring for such use or uses is not necessary for the protection of the public health.

(5) Any economic poison which is adulterated or misbranded or any device which is misbranded.

b. Notwithstanding any other provisions of this Act, no article shall be deemed in violation of this Act when intended solely for export to any foreign country and prepared or packed according to the specifications or directions of the foreign purchaser.

c. It shall be unlawful–

(1) for any person to detach, alter, deface, or destroy, in whole or in part, any label or labeling provided for in this Act or the rules and regulations promulgated hereunder, or to add any substance to, or take any substance from an economic poison in a manner that may defeat the purpose of this Act;

(2) for any manufacturer, distributor, dealer, carrier, or other person to refuse, upon a request in writing specifying the nature or kind of economic poison or device to which such request relates, to furnish to or permit any person designated by the Secretary to have access to and to copy such records as authorized by section 5 of this Act:

(3) for any person to give a guaranty or undertaking provided for in section 7 which is false in any particular, except that a person who receives and relies upon a guaranty authorized under section 7 may give a guaranty to the same effect, which guaranty shall contain in addition to his own name and address the name and address of the person residing in the United States from whom he received the guaranty or undertaking; and

(4) for any person to use for his own advantage or to reveal, other than to the Secretary, or officials or employees of the United States Department of Agriculture or other Federal agencies, or to the courts in response to a subpoena, or to physicians, and in emergencies to pharmacists and other qualified persons, for use in the preparation of antidotes, in accordance with such directions as the Secretary may prescribe, any information relative to formulas of products acquired by authority of section 4 of this Act.

Registration

Sec. 4. a. Every economic poison which is distributed, sold, or offered for sale in any Territory or the District of Columbia, or which is shipped or delivered for shipment from any State, Territory, or the District of Columbia to any other State, Territory, or the District of Columbia, or which is received from any foreign country shall be registered with the Secretary: Provided, That products which have the same formula, are manufactured by the same person, the labeling of which contains the same claims, and the labels of which bear a designation identifying the product as the same economic poison may be registered as a single economic poison: and additional names and labels shall be added by supplement statements; the applicant for registration shall file with the Secretary a statement including

(1) the name and address of the registrant and the name and address of the person whose name will appear on the label, if other than the registrant:

(2) the name of the economic poison.

(3) a complete copy of the labeling accompanying the economic poison and a statement of all claims to be made for it, including the directions for use; and

(4) if requested by the Secretary, a full description of the tests made and the results thereof upon which the claims are based.

b. The Secretary, whenever he deems it necessary for the effective administration of this Act, may require the submission of the complete formula of the economic poison. If it appears to the Secretary that the composition of the article is such as to warrant the proposed claims for it and if the article and its labeling and other material required to be submitted comply with the requirements of section 3 of this Act, he shall register it.

c. If it does not appear to the Secretary that the article is such as to warrant the proposed claims for it or if the article and its labeling and other material required to be submitted do not comply with the provisions of this Act, he shall notify the applicant for registration of the manner in which the article, labeling or other material required to be submitted fail to comply with the Act so as to afford the applicant for registration an opportunity to make the corrections necessary. If, upon receipt of such notice, the applicant for registration does not make the corrections, the Secretary shall refuse to register the article. The Secretary, in accordance with the procedures specified herein, may suspend or cancel the registration of an economic poison whenever it does not appear that the article or its labeling or other material required to be submitted complies with the provisions of this Act. Whenever the Secretary refuses registration of an economic poison or determines that registration of an economic poison should be cancelled, he shall notify the applicant for registration or the registrant of his action and the reasons therefor. Whenever an application for registration is refused, the applicant, within thirty days after service of notice of such refusal, may file a petition requesting that the matter be referred to an advisory committee or file objections and request a public hearing in accordance with this section. A cancellation of registration shall be effective thirty days after service of the foregoing notice unless within such time the registrant (1) makes the necessary corrections; (2) files a petition requesting that the matter be referred to an advisory committee; or (3) files objections and requests a public hearing. Each advisory committee shall be composed of experts, qualified in the subject matter and of adequately diversified professional background selected by the National Academy of Sciences and shall include one or more representatives from land-grant colleges. The size of the committee shall be determined by the Secretary. Members of an advisory committee shall receive as compensation for their services a reasonable per diem, which the Secretary shall be rules and regulations prescribe, for time actually spent in the work of the committee, and shall in addition be reimbursed for their necessary traveling and subsistence expenses while so serving away from their places of residence, all of which costs may be assessed against the petitioner, unless the committee shall recommend in favor of the petitioner or unless the matter was referred to the advisory committee by the Secretary. The members shall not be subject to any other provisions of law regarding the appointment and compensation of employees of the United States. The Secretary shall furnish the committee with adequate clerical and other assistance, and shall by rules and regulations prescribe the procedures to be followed by the committee. The Secretary shall forthwith submit to such committee the application for registration of the article and all relevant data before him. The petitioner, as well as representatives of the United States Department of Agriculture, shall have the right to consult with the advisory committee. As soon as practicable after such submission, but not later than sixty days thereafter, unless extended by the Secretary for an additional sixty days, the committee shall, after independent study of the data submitted by the Secretary and all other pertinent information available to it, submit a report and recommendation to the Secretary as to the registration of the article, together with all underlying data and a statement of the reasons or basis for the recommendations. After due consideration of the views of the committee and all other data before him, the Secretary shall within ninety days after receipt of the report and recommendations of the advisory committee, make his determination and issue an order, with findings of fact, with respect to registration of the article and notify the applicant for registration or registrant. The applicant for registration, or registrant, may within sixty days from the date of the order of the Secretary, file objections thereto and request a public hearing thereon. In the event a hearing is requested, the Secretary shall, after due notice, hold such public hearing for the purpose of receiving evidence relevant and material to the issues raised by such objections. Any report, recommendations, underlying data, and reasons certified to the Secretary by an advisory committee shall be made a part of the record of the hearing, if relevant and material, subject to the provisions of section 7(c) of the Administrative Procedure Act (5 U.S.C. 1006 (c)). The National Academy of Sciences shall designate a member of the advisory committee to appear and testify at any such hearing with respect to the report and recommendations of such committee upon request of the Secretary, the petitioner, or the officer conducting the hearing: *Provided*, That this shall not preclude any other member of the advisory committee from appearing and testifying at such hearing. As soon as practicable after completion of the hearing, but not later than ninety days, the Secretary shall evaluate the data and reports before him, act upon such objections and issue an order granting, denying, or cancelling the registration or requiring modification of the claims or the labeling. Such order shall be based only on substantial evidence of record of such hearing, including any report, recommendations, underlying data, and reason certified to the Secretary by an advisory committee, and shall set forth detailed findings of fact upon which the order is based. In connection with considerations of any registration or application for registration under this section, the Secretary may consult with any other Federal agency or with an advisory committee appointed as herein provided. Notwithstanding the provisions of section 3.c. (4), information relative to formulas of products acquired by authority of this section may be revealed, when necessary under this section to an advisory committee or to any Federal agency consulted, or at a public hearing, or in findings of fact issued by the Secretary. All data submitted to an advisory committee in support of a petition under this section shall be considered confidential by such advisory committee: Provided, That this provision shall not be construed as prohibiting the use of such data by the committee in connection with its consultation with the petitioner or representatives of the United States Department of Agriculture, as provided for herein, and in connection with its report and recommendations to the Secretary. Notwithstanding any other provision of this section, the Secretary may, when he finds that such action is necessary to prevent an imminent hazard to the public, by order, suspend the registration of an economic poison immediately. In such case, he shall give the registrant prompt notice of such action and afford the registrant the opportunity to have the matter submitted to an advisory committee and for an expedited hearing under this section. Final orders of the Secretary under this section shall be subject to judicial review, in accordance with the provisions of subsection d. In no event shall registration of an article be construed as a defense for the commission of any offense prohibited under section 3 of this Act.

d. In a case of actual controversy as to the validity of any order under this section, any person who will be adversely affected by such order may obtain judicial review by filing in the United States court of Appeals for the circuit wherein such person resides or has his principal place of business, or in the United States Court of Appeals for the District of Columbia Circuit, within sixty days after the entry of such order, a petition praying that the order be set aside in whole or in part. A copy of the petition shall be forthwith transmitted by the clerk of the court to the Secretary, or any officer designed by him for that purpose, and thereupon the Secretary shall file in the court the record of the proceedings on which he based his order, as provided in section 2112 of title 28, United States Code. Upon the filing of such petition the court shall have exclusive jurisdiction to affirm or set aside the order complained of in whole or in part. The findings of the Secretary with respect to questions of fact shall be sustained if supported by substantial evidence when considered on the record as a whole, including any report and recommendations of an advisory committee. If application is made to the court for leave to adduce additional evidence, the court may order such additional evidence to be taken before the Secretary, and to be adduced upon the hearing in such manner and upon such terms and conditions as to the court may seem proper, if such evidence is material and there were reasonable grounds for failure to adduce such evidence in the proceedings below. The Secretary may modify his findings as to the facts and order by reason of the additional evidence so taken, and shall file with the court such modified findings and order. The judgment of the court affirming or setting aside, in whole or in part, any order under this section shall be final, subject to review by the Supreme Court of the United States Code. The commencement of proceedings under this section shall not, unless specifically ordered by the court to the contrary, operate as a stay of an order. The court shall advance on the docket and expedite that disposition of all causes filed therein pursuant to this section.

e. Notwithstanding any other provisions of this Act, registration is not required in the case of an economic poison shipped from one plant to another plant operated by the same person and used solely at such plant as a constitutent part to make an economic poison which is registered under this Act.

f. The Secretary is authorized to cancel the registration of any economic poison at the end of a period of five years following the registration of such economic poison or at the end of any five-year period thereafter, unless the registrant, prior to the expiration of each such five-year period, requests in accordance with regulations issued by the Secretary that such registration be continued in effect.

Books and Records

Sec. 5. For the purposes of enforcing the provisions of this Act, any manufacturer, distributor, carrier, dealer, or any other person who sells or offers for sale, delivers, or offers for delivery, or who receives or holds any economic poison or device subject to this Act, shall, upon request of any employee of the United States Department of Agriculture or any employee of any State, Territory, or political subdivision, duly designated by the Secretary, furnish or permit such person at all reasonable times to have access to, and to copy all records showing the delivery, movement, or holding of such economic poison or device, including the quantity, the date of shipment and receipt, and the name of the consignor and consignee; and in the event of the inability of any person to produce records containing such information, all other records and information relating to such delivery, movement, or holding of the economic poison or device. Notwithstanding this provision, however, the specific evidence obtained under this section shall not be used in a criminal prosecution of the person from whom obtained.

Enforcement

Sec. 6. a. The Secretary (except as otherwise provided in this section) is authorized to make rules and regulations for carrying out the provisions of this Act, including the collection and examination of samples of economic poisons and devices subject to this Act and the determination and establishment of suitable names to be used in the ingredient statement. The Secretary is in addition, authorized after opportunity for hearing—

(1) to declare a pest any form of plant or animal life or virus which is injurious to plants, man, domestic animals, articles, or substances;

(2) to determine economic poisons, and quantities of substances contained in economic poisons, which are highly toxic to man; and

(3) to determine standards of coloring or discoloring for economic poisons, and to subject economic poisons to the requirements of section 3.a. (4) of this Act.

b. The Secretary of the Treasury and the Secretary of Agriculture shall jointly prescribe the regulations for the enforcement of section 10 of this Act.

c. The examination of economic poisons or devices shall be made in the United States Department of Agriculture or elsewhere as the Secretary may designate for the purpose of determining from such examination whether they comply with the requirements of this Act, and if it shall appear from any such examination that they fail to comply with the requirements of this Act, the Secretary shall cause notice to be given to the person against whom criminal proceedings are contemplated. Any person so notified shall be given an opportunity to present his views, either orally or in writing, with regard to such contemplated proceedings, and if in the opinion of the Secretary it appears that the provisions of this Act have been violated by such person, then the Secretary shall certify the facts to the proper United States attorney, with a copy of the results of the analysis of the examination of such article: *Provided,* That nothing in this Act shall be construed as requiring the Secretary to report for prosecution or for the institution of libel proceedings minor violations of this Act whenever he believes that the public interest will be adequately served by a suitable written notice of warning.

d. It shall be the duty of each United States attorney, to whom the Secretary or his agents shall report any violation of this Act, to cause appropriate proceedings to be commenced and prosecuted in the proper courts of the United States without delay.

e. The Secretary shall, by publication in such manner as he may prescribe, give notice of all judgments entered in actions instituted under the authority of this Act.

Exemptions

Sec. 7. a. The penalties provided for a violation of section 3.a. of this Act shall not apply to–

(1) any person who establishes a guaranty signed by, and containing the name and address of, the registrant or person residing in the United States from whom he purchased and received in good faith the article in the same unbroken package, to the effect that the article was lawfully registered at the time of sale and delivery to him, and that it complies with the other requirements of this Act, designating this Act. In such case the guarantor shall be subject to the penalties which would otherwise attach to the person holding the guaranty under the provision of this Act;

(2) any carrier while lawfully engaged in transporting an economic poison or device if such carrier upon request by a person duly designated by the Secretary shall permit such person to copy all records showing the transactions in and movement of the articles:

(3) to public officials while engaged in the performance of their official duties;

(4) to the manufacturer or shipper of an economic poison for experimental use only by or under the supervision of any Federal or State agency authorized by law to conduct research in the field of economic poisons; or by others if a permit has been obtained before shipment in accordance with regulations promulgated by the Secretary.

Penalties

Sec. 8. a. Any person violating section 3.a. (1) of this Act shall be guilty of a misdemeanor and shall on conviction be fined not more than $1,000.

b. Any person violating any provision other than section 3.a. (1) of this Act shall be guilty of a misdemeanor and shall upon conviction be fined not more than $500 for the first offense, and on conviction for each subsequent offense be fined not more than $1,000 or imprisoned for not more than one year, or both such fine and imprisonment: *Provided,* That an offense committed more than five years after the last previous conviction shall be considered a first offense. An article the registration of which has been terminated may not again be registered unless the article, its labeling, and other material required to be submitted appear to the Secretary to comply with all the requirements of this Act.

c. Notwithstanding any other provision of this Section, in case any person with intent to defraud, uses or reveals information relative to formulas of products acquired under the authority of section 4 of this Act, he shall be fined not more than $10,000 or imprisoned for not more than three years, or both such fine and imprisonment.

d. When construing and enforcing the provisions of this Act, the act, omission or failure, of any officer, agent, or other person acting for or employed by any person shall in every case be also deemed to be the act, omission, of failure of such person as well as that of the person employed.

Seizures

Sec. 9. a. Any economic poison or device that is being transported from one State, Territory, or District to another, or having been transported, remains unsold or in original unbroken packages, or that is sold or offered for sale in the District of Columbia or any Territory, or that is imported from a foreign country, shall be liable to be proceeded against in any district court of the United States in the district where it is found and seized for confiscation by a process of libel for condemnation–

(1) in the case of an economic poison–

(a) if it is adulterated or misbranded;

(b) if it is not registered pursuant to the provisions of section 4 of this Act;

(c) if it fails to bear on its label the information required by this Act;

(d) if it is a white powder, economic poison, and is not colored as required under this Act; or

(2) in the case of a device if it is misbranded.

b. If the article is condemned it shall, after entry of the decree, be disposed of by destruction or sale as the court may direct and the proceeds, if sold, less the legal costs, shall be paid into the Treasury of the United States, but the article shall not be sold contrary to the provisions of this

Act or of the laws of the jurisdiction in which it is sold; *Provided,* That upon the payments of the costs of the libel proceedings and the execution and delivery of a good and sufficient bond conditioned that the article shall not be sold or otherwise disposed of contrary to the provisions of this Act or the laws of any State, Territory, or District in which sold, the court may direct that such articles be delivered to the owner thereof. The proceedings of such libel cases shall conform, as near as may be, to the proceedings in admiralty, except that either party may demand trial by jury of any issue of fact joined in any case, and all such proceedings shall be at the suit of and in the name of the United States.

c. When a decree of condemnation is entered against the article, court costs and fees, storage, and other proper expenses shall be awarded against the person, if any, intervening as claimant of the article.

Imports

Sec. 10. The Secretary of the Treasury shall notify the Secretary of Agriculture of the arrival of economic poisons and devices offered for importation and shall deliver to the Secretary of Agriculture, upon his request, samples of economic poisons or devices which are being imported or offered for import into the United States, giving notice to the owner or consignee, who may appear before the Secretary of Agriculture and have the right to introduce testimony. If it appears from the examination of a sample that it is adulterated, or misbranded or otherwise violates the prohibitions set forth in this Act, or is otherwise dangerous to the health of the people of the United States, or is of a kind forbidden entry into or forbidden to be sold or restricted in sale in the country in which it is made or from which it is exported, the said article may be refused admission, and the Secretary of the Treasury shall refuse delivery to the consignee and shall cause the destruction of any goods refused delivery which shall not be exported by the consignee within three months from the date of notice of such refusal under such regulations as the Secretary of the Treasury may prescribe: *Provided,* That the Secretary of the Treasury may deliver to the consignee such goods pending examination and decision in the matter on execution of penal bond for the amount of the full invoice value of such goods, together with the duty thereon, and on refusal to return such goods for any cause to the custody of the Secretary of Treasury, when demanded, for the purpose of excluding them from the country, or for any other purpose, said consignee shall forfeit the full amount of said bond: and provided further, That all charges for storage, cartage, and labor on goods which are refused admission or delivery shall be paid by the owner or consignee and in default of such payment shall constitute a lien against any future importation made by such owner or consignee.

Delegation of Duties

Sec. 11. All authority vested in the Secretary by virtue of the provisions of this Act may with like force and effect be executed by such employees of the United States Department of Agriculture as the Secretary may designate for the purpose.

Authorization for Appropriations and Expenditures

Sec. 12. a. There is hereby authorized to be appropriated, out of any moneys in the Treasury not otherwise appropriated, such sums as may be necessary for the purposes and administration of this Act. In order to carry out the provisions of this Act, which take effect prior to the repeal of the Insecticide Act of 1910, appropriations available for the enforcement of such Act are authorized to be made available.

b. The Secretary is authorized from the funds appropriated for this Act to make such expenditures as he deems necessary, including rents, travel supplies, books, samples, testing devices, furniture, equipment, and such other expenses as may be necessary to the administration of this Act.

Cooperation

Sec. 13. The Secretary is authorized to cooperate with any other department or agency of the Federal Government and with the official agricultural or other regulatory agency of any State, or any State, Territory, District, possession, or any political subdivision thereof, in carrying out the provisions of this Act, and in securing uniformity of regulations.

Separability

Sec. 14. If any provision of this Act is declared unconstitutional, or the applicability thereof to any person or circumstances is held invalid, the constitutionality of the remainder of this Act and the applicability thereof to other persons and circumstances shall not be affected thereby.

INTERDEPARTMENTAL AGREEMENTS ON PESTICIDES

(Interdepartmental Agreement for Protection of Public Health and Quality of Environment announced March 3, 1970, and establishment of a working group of the Subcommittee on Pesticides of the Cabinet Committee on the Environment announced March 26, 1970)

INTERDEPARTMENTAL AGREEMENT

Purpose. Coordination of the activities of the three Departments pertaining to economic poisons as defined in section 2 of the Federal Insecticide, Fungicide, and Rodenticide Act (7 U.S.C. 135), hereinafter referred to as pesticides, with reference to the review of current or proposed registrations to assure maximum protection of the public health, the well being of man, and the quality of the environment.

Existing departmental responsibilities. Each of the three Departments has certain statutory authority and responsibility relating to pesticides in the environment, as set forth below:

Department of Agriculture

1. Statutory authority under the Federal Insecticide, Fungicide, and Rodenticide Act for registration of pesticides.

2. Responsibility for research, education, information, regulatory, and action programs designed to protect the well being of man, crops, livestock, forests, ranges, habitats, products, structures, and premises against arthropod and other invertebrate pests, weeds, and fungi with equal concern for the protection of beneficial nontarget organisms and the quality of the environment.

Department of Health, Education, and Welfare

DHEW has the statutory authority and responsibility under the Federal Food, Drug, and Cosmetic Act for establishing safe tolerances for pesticides in or on raw agricultural commodities, processed food and potable water. The Department also has responsibilities for protecting the public from health, occupational, and environmental hazards related to the use and disposal of pesticides, and for other public health aspects such as the control of diseases and their vectors.

Department of Interior

USDI has statutory authority and responsibility under the Federal Water Pollution Control Act to carry out programs, to protect and enhance the quality of the Nation's waters including determining the effects of pesticides in water on health, welfare, and aquatic life. These responsibilities include establishing water quality standards for interstate waters. The Department also has statutory authority for the conservation of wild birds, fish, mammals, their food organisms and their environment as affected by pesticides and the appraisal of effects of pesticides on fish and wildlife.

Information. Each Department will keep each of the other Departments fully informed of developments in knowledge from research or other sources which may come into its possession in connection with matters referred to in this agreement. High priority shall be placed by each Department representative to respond to each of the other Departments' requests, whether written or oral, for any and all information concerning action pending or taken on pesticide matters.

Procedures – A. *General.* 1. Each Department will designate a qualified representative to act on behalf of such Department in carrying out the terms of this agreement. All communications from USDA, DHEW, and USDI will be directed to these representatives.

2. USDA shall furnish to the other Departments copies of each proposal received for registration or reregistration with the accompanying safety data (if any) and a request for an opinion from DHEW and USDI on the requested action in their areas of responsibility.

3. Within 15 working days, DHEW and USDI shall evaluate each registration or reregistration proposal in light of the data supplied and offer an opinion or provide a status report as to whether or not the registration should be granted or specify the additional data deemed necessary before such evaluation can be made. When either is unable to assess the public health or environmental risk without additional data, USDA shall advise the registrant of its inability to consider registration of the pesticide until the additional data requested have been received and reviewed by the respective Departments according to the following procedures described below.

B. *Specific.* 1. The Departmental Representative will accomplish review by his agency of each proposal and report results of such review to each of the other agencies within 15 working days of the receipt of the proposal. If there is insufficient information to reach a decision of the proposal, USDA will be contacted within such period of 15 working days and advised with particularity what additional information is needed for the necessary evaluation. Applicants for registration should not be discouraged from communicating with DHEW or USDI on registration matters of mutual interest, so long as the other representatives are informed of the details of such contact by memorandum thereof.

2. Upon receipt of such a request for further information, USDA will make arrangements to obtain the additional information, if available, and furnish it to the Department making the request. USDA will withhold final action on the matter for 15 working days, from the date of furnishing the requested information or advice that such information is not available, pending receipt of the report of the other Department of the results of further review.

3. If a Department concludes that the registration should be rejected in whole or in part, this view shall be expressed in writing along with a statement of the reasons for the conclusion including the specific information, lack of information, or scientific judgment upon which these are based.

Upon being so notified, USDA will notify the party involved, i.e., the applicant or registrant, and offer him an opportunity to submit any data, views or arguments with respect to the proposed rejection and any such submission shall be promptly referred to the other Department representatives who shall report to USDA the results of their review of the submission.

4. In the event that after the review of the additional data the Departments cannot agree on the approval of the proposal, any Department may request the formation of a Registration Review Panel for the purpose of making a complete review of the issues and related information or lack thereof and submit a detailed report of their findings. Each Registration Review Panel shall be composed of two representatives from each of the three Departments with the chairman to be selected from the respresentatives of the Department from which the objections have come.

The Registration Review Panel shall prepare its report within 20 working days, including any minority opinions, and submit it to each of the three Departments.

5. The report(s) of the Registration Review Panel shall be reviewed by each Department within 15 working days of its receipt.

6. If significant differences between the Departments remain still unresolved, all data and information submitted by all parties shall be reviewed at the first monthly Interdepartment Pesticide Meeting after the reviews of the Registration Review Panel reports have been made.

7. In the event agreement is not reached among the Department representatives at the monthly Interdepartment Pesticide Meeting, a submission of the reports of the reviews referred to in paragraphs B-1 through B-6 above, will be referred at the request of the Secretary of the objecting Department to the Cabinet Committee on Environmental Quality. The referral shall be accompanied by a statement prepared by each Department analyzing the issues involved and setting forth the decision it recommends. The Cabinet Committee on Environmental Quality will consider such recommendations and make a written report, either accepting, rejecting, or modifying them.

8. Based upon consideration of the action of the Cabinet Committee, the Secretary of Agriculture will make the decision as to the specific action to be taken with respect to the matter on which the Department representatives were not in agreement, and will thereupon notify the other two Secretaries in writing in advance of the publication of the final determination if he has not followed the recommendations made by the objecting Department(s), specifically stating his reasons for such action.

9. When registration is granted, USDA shall supply to DHEW and USDI final printed labeling at the time of registration with a copy of the final letter to the registrant.

10. The Departmental representatives may review existing patterns of usage and registrations for particular pesticides. A conclusion by USDA, DHEW, or USDI that an existing pesticide use or registration may be detrimental to the public health or to the quality of the environment shall be transmitted to the other two Departments together with the supporting reasoning and information, with a recommendation for corrective action. Written information from all sources on the health or environmental aspects of such pesticides shall be submitted to a Registration Review Panel for review and recommendations. If USDA, DHEW, or USDI disagrees with the recommendations of the Registration Review Panel, that Department can initiate further review by the procedural steps described in paragraphs B-6 through B-8 above.

Interdepartment pesticide meetings and conferences. The Department representatives will meet jointly at an Interdepartment Pesticide Meeting once a month to provide a continuous dialogue concerning all aspects of their current activities and to promote cooperation and understanding among the Departments. Monthly reports concerning their activities will be made to the Secretaries of the three Departments, according to a mutually agreed upon format.

The Departmental representatives will arrange a general conference at least once each year to discuss research needs, research program and policy, and the application of research findings in action programs, including public information relating to pesticides. The Interdepartment Pesticide Conference will consider broad questions on policies relating to pesticides involving the interrelationships of control programs, research, registration, tolerances, the public health, and general departmental recommendations to the public.

In order to promote free interchange or information among the Departments involved under this agreement, each Department representative should be invited and encouraged to participate in conferences, meetings, and various symposiums with Federal, State, university, or industry people on possible matters of mutual interest.

Effective date and supersedure. This agreement shall become effective upon signature by the Secretaries of USDA, USDI, and DHEW, and shall supersede the agreement entitled "Interdepartmental Coordination of Activities Relating to Pesticides by the Department of Agriculture, the Department of Health, Education, and Welfare, and the Department of the Interior," published in the FEDERAL REGISTER on May 1, 1964 (29 F.R. 5808).

CHARTER OF THE WORKING GROUP

A. *Establishment.* A working group of the Subcommittee on Pesticides of the Cabinet Committee on the Environment (formerly Environmental Quality Council) is established pursuant to action of the Committee (Council) announced on November 20, and the Federal Committee on Pest Control is hereby abolished.

The working group will: (1) Provide day-to-day coordination of Federal agency pesticide activities; and (2) develop program and policy proposals for consideration by the Subcommittee on Pesticides.

The following agencies will have membership on the working groups:

Department of Agriculture.
Department of Health, Education, and Welfare.
Department of the Interior.
Department of Defense.
Department of Transportation.
Department of State.[1]

The Office of Science and Technology, the Bureau of the Budget, and the Office of Intergovernmental Relations will be invited to designate an observer at the meetings of the working group. Other agencies will be invited to participate in meetings when matters of significant concern to them are to be discussed.

The working group will consist of one principal authorized to commit his agency in routine coordination and on most issues and to make reservations on behalf of his agency on controversial issues. At the request of any principal, Departmental or agency issues will be referred to the Subcommittee on Pesticides for review prior to implementation.

Each member agency will name one or more alternates to speak for that agency in the absence of the principal. Other individuals, cognizant of the pesticide programs and responsibilities of their agencies, may attend meetings to provide technical support for the principal.

It is recognized that the use of pesticide chemicals is necessary to protect man, animals, plants, and the environment against harmful insects, rodents, other vertebrate pests, weeds, and diseases. It is further recognized that use of pesticide chemicals, especially careless and unauthorized use, is hazardous to nontarget man, plants, and animals, and the environment. It is, therefore, essential that any use of a pesticide chemical be evaluated as to the necessity for its use, the harm which may result, and the precautions which must be taken to minimize harmful effects.

B. *Purpose.* The working group is the primary staff level coordinating mechanism for Federal activities concerning pesticides, pests, and their control. The activities coordinated by the working group include, but are not limited to:

(1) Pest control programs in various parts of the world in which there is active participation on the part of the Federal Government, either in funding or in supervision;

(2) Research on pests and their control and effects of control procedures, whether by chemical or other methods;

(3) Monitoring of the environment for pesticides and their residues;

(4) Establishment of pesticide investigation teams to conduct special investigations of pesticide problems which arise or which may be anticipated;

(5) Public information on pest control and the use of pesticides;

(6) Evaluation of economic and social values and risks involved in the control of pests by various methods; and

(7) Advice to the interdepartmental group on pesticide registration on problems that it believes should be considered by that group.

The working group shall advise the Subcommittee on Pesticides and the appropriate Federal departments and agencies concerning matters of common interest. In no case, however, will the working group supersede the responsibility of each department and agency to carry out the functions assigned to it by legislative and executive mandates. The working group will encourage exchange of information among international, Federal, State, and local agencies and may participate with them as appropriate.

C. *Procedures* – 1. Review of programs. a. On request, any Federal agency shall submit to the working group for review a detailed description of its proposed and current pest control programs and monitoring, research, education, and other programs pertaining to pest control.

b. The working group will review such programs from the standpoint of effectiveness, economic impact and hazards to human health, to livestock and crops, to fish or wildlife, and to other elements of the environment.

c. Based on such review, the working group shall recommend to the heads of the departments or agencies concerned such modifications in the programs as the working group feels will best serve the public interest.

2. Intergovernmental cooperation. a. The working group shall promote or encourage review of both Federal and non-Federal programs by State and local groups representing a broad spectrum of interests and responsibilities.

b. The working group may communicate with such State and local groups to receive their recommendations and to make recommendations to them either directly or through member departments, whichever seems most expeditious and effective

c. Subject to foreign policy guidance from the Department of State, the working group may participate in joint activities with foreign or international groups having similar interests and will coordinate these activities among Federal and State agencies. Informal recommendations arising from such joint activities may be directed by the working group to the concerned Federal department or agency. No formal recommendations shall be transmitted directly to any foreign government or international agency

3. Stimulation of new activities. a. Whenever the working group feels that the public interest will be served by the initiation of new activity, such as interdepartmental participation in integrating a variety of control methods or in analyzing jointly the efforts of such integrated control on all aspects of the environments, the working group may recommend appropriate action to the Subcommittee on Pesticides and to the concerned departments or agencies and representatives of States.

4. Mechanisms available to the working group. a. The working group may establish ad hoc groups or panels of specialists to assist in discharging the working group's

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[1] The intent is to assure adequate consideration of international concerns which are largely but not wholly represented within the Agency for International Development.

responsibilities. Membership on such ad hoc groups need not be limited to representatives of Federal departments.

b. The working group may request the appropriate agencies to provide special services, consultation, staff, facilities, publications, conferences, etc., as may facilitate the work of the working group. Expenditure of appropriated funds for such activities of the working group must be within the authority and area of responsibility of the contributing department or agency and must remain within its individual fiscal control, even though the technical supervision may be provided by the working group.

D. *Membership.* Membership and observer status on the working group is by appointment of principals and alternates by letter, to the Chairman of the Subcommittee on Pesticides, from the heads of agencies concerned. On invitation of the working group, a liaison representative may be similarly appointed by other Government agencies having an interest in problems related to pest control.

E. *Officers and staff.* 1. The officers of the working group shall be:

Chairman.
Vice Chairman.
Executive Secretary.

The Chairman and Vice Chairman shall be elected from among members of the working group.

2. The staff of the working group shall include such professional and other staff as may be required.

3. It shall be the duty of the Chairman to preside at all meetings and to assure compliance with the charter of the working group. He shall call meetings of the working group when he deems it necessary or on request of any member department. The Chairman shall exercise leadership in seeking timely interagency coordination on items of concern to the working group. The Chairman shall communicate directly with the Chairman of the Subcommittee on Pesticides as needed.

4. In the absence of the Chairman, the Vice Chairman will perform the functions of the Chairman.

5. The Executive Secretary will be responsible for:

a. Preparation of agenda, notice of meetings, correspondence, coordination of administrative matters and representation of the working group as requested by the Chairman.

b. Preparation and recommendation to the working group of pertinent policies and plans to meet the working group requirements. To this end, the Executive Secretary may request the Chairman to appoint advisory and other ad hoc groups as required.

c. Maintenance of minutes, sufficient other records and accounts to provide an annual report of the working group activities for such distribution as recommended by the working group.

F. *Meetings.* 1. Meetings shall be held at the call of the Chairman, following coordination with members regarding time, place, and date.

2. Decisions of the working group usually shall be made at regular meetings where there is an opportunity for discussion and not by correspondence or telephone calls, except in rare cases of urgency.

3. Minutes of meetings shall consist of a record of important discussions and decisions of the working group, but need not be a verbatim record. Minutes shall be distributed to principals, alternates, and observers.

G. *Quorum.* A majority of the members of the working group shall constitute a quorum authorized to transact any business duty presented at any meeting of the working group.

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Union Calendar No. 235

92d CONGRESS
1st Session

H. R. 10729

[Report No. 92-511]

IN THE HOUSE OF REPRESENTATIVES

September 16, 1971

Mr. Poage (for himself, Mr. Belcher, Mr. Goodling, Mr. Bergland, and Mr. Sisk) introduced the following bill; which was referred to the Committee on Agriculture

September 25, 1971

Committed to the Committee of the Whole House on the State of the Union and ordered to be printed

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A BILL

To amend the Federal Insecticide, Fungicide, and Rodenticide Act, and for other purposes.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That this Act may be cited as the "Federal Environmental Pesticide Control Act of 1971".

AMENDMENTS TO FEDERAL INSECTICIDE, FUNGICIDE, AND RODENTICIDE ACT

Sec. 2. The Federal Insecticide, Fungicide, and Rodenticide Act (7 U.S.C. 135 et seq.) is amended to read as follows:

"SEC. 1. SHORT TITLE AND TABLE OF CONTENTS.

"(a) Short Title.—This Act may be cited as the 'Federal Insecticide, Fungicide, and Rodenticide Act'.

VI--O

"(b) TABLE OF CONTENTS.—

"Section 1. Short title and table of contents.
  "(a) Short title.
  "(b) Table of contents.
"Sec. 2. Definitions.
  "(a) Active ingredient.
  "(b) Administrator.
  "(c) Adulterated.
  "(d) Animal.
  "(e) Certified pesticide applicator, etc.
    "(1) Certified pesticide applicator.
    "(2) Private pesticide applicator.
    "(3) Commercial pesticide applicator.
  "(f) Defoliant.
  "(g) Desiccant.
  "(h) Device.
  "(i) District court.
  "(j) Environment.
  "(k) Fungus.
  "(l) Imminent hazard.
  "(m) Inert ingredient.
  "(n) Ingredient statement.
  "(o) Insect.
  "(p) Label and labeling.
    "(1) Label.
    "(2) Labeling.
  "(q) Misbranded.
  "(r) Nematode.
  "(s) Person.
  "(t) Pest.
  "(u) Pesticide.
  "(v) Plant regulator.
  "(w) Producer and produce.
  "(x) Protect health and the environment.
  "(y) Registrant.
  "(z) Registration.
  "(aa) State.
  "(bb) Substantial adverse effects on the environment.
  "(cc) Weed.
"Sec. 3. Registration of pesticides.
  "(a) Requirement.
  "(b) Exemptions.
  "(c) Procedure for registration.
    "(1) Statement required.
    "(2) Data in support of registration.
    "(3) Time for acting with respect to application.
    "(4) Notice of application.
    "(5) Approval of registration.
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  "(d) Classification of pesticides.
    "(1) Classification for general use, restricted use, or both.
    "(2) Change in classification.

"Sec. 3. Registration of pesticides.—Continued
  "(e) Products with same formulation and claims.
  "(f) Miscellaneous.
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"Sec. 4. Use of restricted use pesticide; certified applicators.
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"Sec. 5. Experimental use permits.
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"Sec. 6. Administrative review; suspension.
  "(a) Cancellation after five years.
    "(1) Procedure.
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    "(1) Order.
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    "(3) Judicial review.
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"Sec. 7. Registration of establishments.
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  "(d) Confidential records and information.
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"Sec. 9. Inspection of establishments, etc.
  "(a) In general.
  "(b) Warrants.
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    "(1) Certification of facts to Attorney General.
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"Sec. 10. Protection of trade secrets, etc.
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  "(b) Disclosure.
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  "(a) In general.
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"Sec. 12. Unlawful acts.
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"Sec. 13. Stop sale, use, removal, and seizure.
  "(a) Stop sale, etc., orders.
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"Sec. 14. Penalties.
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    "(1) In general.
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"Sec. 19. Disposal and transportation.
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  "(a) Research.
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"Sec. 22. Delegation and cooperation.
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  "(a) Cooperative agreements.
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  "(a) Regulations.
  "(b) Exemption of pesticides.
  "(c) Other authority.
"Sec. 26. Severability.
"Sec. 27. Authorization for appropriations.

"SEC. 2. DEFINITIONS.

"For purposes of this Act—

"(a) ACTIVE INGREDIENT.—The term 'active ingredient' means—

"(1) in the case of a pesticide other than a plant regulator, defoliant, or desiccant, an ingredient which will prevent, destroy, repel, or mitigate any pest;

"(2) in the case of a plant regulator, an ingredient which, through physiological action, will accelerate or retard the rate of growth or rate of maturation or otherwise alter the behavior of ornamental or crop plants or the product thereof;

"(3) in the case of a defoliant, an ingredient which will cause the leaves or foliage to drop from a plant; and

"(4) in the case of a desiccant, an ingredient which will artificially accelerate the drying of plant tissue.

"(b) ADMINISTRATOR.—The term 'Administrator' means the Administrator of the Environmental Protection Agency.

"(c) ADULTERATED.—The term 'adulterated' applies to any pesticide if:

"(1) its strength or purity falls below the professed standard or quality as expressed on its labeling under which it is sold;

"(2) any substance has been substituted wholly or in part for the pesticide; or

"(3) any valuable constituent of the pesticide has been wholly or in part abstracted.

"(d) ANIMAL.—The term 'animal' means all vertebrate and invertebrate species, including but not limited to man and other mammals, birds, fish, and shellfish.

"(e) CERTIFIED PESTICIDE APPLICATOR, ETC.—

"(1) CERTIFIED PESTICIDE APPLICATOR.—The term 'certified pesticide applicator' means any individual who is certified under section 4 as authorized to use or supervise the use of any pesticide which is classified for restricted use.

"(2) PRIVATE PESTICIDE APPLICATOR.—The term 'private pesticide applicator' means a certified pesticide applicator who uses or supervises the use of any pesticide which is classified for restricted use for purposes of producing any agricultural commodity on property owned or rented by him or (if applied without compensation other than trading of personal services between producers of agricultural commodities) on the property of another person.

"(3) COMMERCIAL PESTICIDE APPLICATOR.—The term 'commercial pesticide applicator' means a certified pesticide applicator (whether or not he is a private pesticide applicator with respect to some uses) who uses or supervises the use of any pesticide which is classified for restricted use for any purpose or on any property other than as provided by paragraph (2).

"(f) DEFOLIANT.—The term 'defoliant' means any substance or mixture of substances intended for causing the leaves or foliage to drop from a plant, with or without causing abscission.

"(g) DESICCANT.—The term 'desiccant' means any substance or mixture of substances intended for artificially accelerating the drying of plant tissue.

"(h) DEVICE.—The term 'device' means any instrument or contrivance (other than a firearm) which (1) is intended for trapping, destroying, repelling, or mitigating any pest or any other form of plant or animal life (other than man and other than bacteria, virus, or other micro-organism on or in living man or other living animals), and (2) is within a class of devices in respect of which the Administrator has made the determination referred to in section 25(c)(4).

"(i) DISTRICT COURT.—The term 'district court' means a United States district court, the District Court of Guam, the District Court of the Virgin Islands, and the highest court of American Samoa.

"(j) ENVIRONMENT.—The term 'environment' includes water, air, land, and all plants and man and other animals living therein, and the interrelationships which exist among these.

"(k) FUNGUS.—The term 'fungus' means any non-chlorophyll-bearing thallophyte (that is, any non-chlorophyll-bearing plant of a lower order than mosses and liverworts), as for example, rust, smut, mildew, mold, yeast, and bacteria, except those on or in living man or other animals and those on or in processed food, beverages, or pharmaceuticals.

"(l) IMMINENT HAZARD.—The term 'imminent hazard' means a situation which exists when the continued use of a pesticide during the time required for cancellation proceeding would likely result in substantial adverse effects on the environment.

"(m) INERT INGREDIENT.—The term 'inert ingredient' means an ingredient which is not active.

"(n) INGREDIENT STATEMENT.—The term 'ingredient statement' means a statement which contains—

"(1) the name of each active ingredient in the pesticide;

"(2) if all the uses of the pesticide are classified for general use, then either—

"(i) the total percentage of all inert ingredients, and of all active ingredients, in the pesticide; or

"(ii) the percentage of each active ingredient, and the total percentage of all inert ingredients, in the pesticide; and if all the uses of the pesticide are not classified for general use, then the information required under (ii); and

"(3) if the pesticide contains arsenic in any form, a statement of the percentages of total and water soluble arsenic, calculated as elemental arsenic.

"(o) INSECT.—The term 'insect' means any of the numerous small invertebrate animals generally having the body more or less obviously segmented, for the most part belonging to the class insecta, comprising six-legged, usually winged forms, as for example, beetles, bugs, bees, flies, and to other allied classes of arthropods whose members are wingless and usually have more than six legs, as for example, spiders mites, ticks, centipedes, and wood lice.

"(p) LABEL AND LABELING.—

"(1) LABEL.—The term 'label' means the written, printed, or graphic matter on, or attached to, the pesticide or device or any of its containers or wrappers.

"(2) LABELING.—The term 'labeling' means all labels and all other written, printed, or graphic matter—

"(A) accompanying the pesticide or device at any time; or

"(B) to which reference is made on the label or in literature accompanying the pesticide or device, except to current official publications of the Environmental Protection Agency, the United States Departments of Agriculture and Interior, the Department of Health, Education, and Welfare, State experiment stations, State agricultural colleges, and other similar Federal or State institutions or agencies authorized by law to conduct research in the field of pesticides.

"(q) MISBRANDED.—

"(1) A pesticide or device subject to this Act is misbranded if—

"(A) its labeling bears any statement, design, or graphic representation relative thereto or to its ingredients which is false or misleading in any particular;

"(B) it is contained in a package or other container or wrapping which does not conform to the standards established by the Administrator pursuant to section 25(c)(3);

"(C) it is an imitation of, or is offered for sale under the name of, another pesticide or device;

"(D) its labeling does not bear the registration number assigned under section 7 to each establishment in which it was produced;

"(E) any word, statement, or other information required by or under authority of this Act to appear on the label or labeling is not prominently placed thereon with such conspicuousness (as compared with other words, statements, designs, or graphic matter in the labeling) and in such terms as to render it likely to be read and understood by the ordinary individual under customary conditions of purchase and use;

"(F) if the labeling accompanying it does not contain directions for use which are necessary for effecting the purpose for which the product is intended and if complied with, together with any requirements imposed under section 3 (d) of this Act, is adequate to protect health and the environment; or

"(G) if the label does not contain a warning or caution statement which may be necessary and if complied with, together with any requirements imposed under section 3 (d) of this Act, is adequate to protect health and the environment.

"(2) A pesticide is misbranded if—

"(A) the label does not bear an ingredient statement on that part of the immediate container (and on the outside container or wrapper, if there be one, through which the ingredient statement on the immediate container cannot be clearly read, of the retail package) which is presented or displayed under customary conditions of purchase, except that a pesticide is not misbranded under this subparagraph if:

"(i) the size or form of the immediate container, or the outside container or wrapper of the retail package, makes it impracticable to place the ingredient statement on the part which is presented or displayed under customary conditions of purchase; and

"(ii) the ingredient statement appears prominently on another part of the immediate container, or outside container or wrapper, permitted by the Administrator;

"(B) the labeling does not contain a statement of the use classification under which the product is registered;

"(C) there is not affixed to its container, and to the outside container or wrapper of the retail package, if there be one, through which the required information on the immediate container cannot be clearly read, a label bearing—

"(i) the name and address of the producer, registrant, or person for whom produced;

"(ii) the name, brand, or trademark under which the pesticide is sold;

"(iii) the net weight or measure of the content: *Provided*, That the Administrator may permit reasonable variations; and

"(iv) when required by regulation of the Administrator to effectuate the purposes of this Act, the registration number assigned to the pesticide under this Act, and the use classification; and

"(D) the pesticide contains any substance or substances in quantities highly toxic to man, unless the label shall bear, in addition to any other matter required by this Act—

"(i) the skull and crossbones;

"(ii) the word 'poison' prominently in red on a background of distinctly contrasting color: and

"(iii) a statement of a practical treatment (first aid or otherwise) in case of poisoning by the pesticide.

"(r) NEMATODE.—The term 'nematode' means invertebrate animals of the phylum nemathelminthes and class nematoda, that is, unsegmented round worms with elongated, fusiform, or saclike bodies covered with cuticle, and inhabiting soil, water, plants, or plant parts; may also be called nemas or eelworms.

"(s) PERSON.—The term 'person' means any individual, partnership, association, corporation, or any organized group of persons whether incorporated or not.

"(t) PEST.—The term 'pest' means (1) any insect, rodent, nematode, fungus, weed, or (2) any other form of terrestrial or aquatic plant or animal life or virus, bacteria, or other micro-organism (except viruses, bacteria, or other micro-organisms on or in living man or other living animals) which the Administrator declares to be a pest under section 25(c)(1).

"(u) PESTICIDE.—The term 'pesticide' means (1) any substance or mixture of substances intended for preventing, destroying, repelling, or mitigating any pest, and (2) any substance or mixture of substances intended for use as a plant regulator, defoliant, or desiccant.".

"(v) PLANT REGULATOR.—The term 'plant regulator means any substance or mixture of substances, intended through physiological action, for accelerating or retarding the rate of growth or rate of maturation, or for otherwise altering the behavior of plants or the produce thereof, but shall not include substances to the extent that they are intended as plant nutrients, trace elements, nutritional chemicals, plant inoculants, and soil amendments.

"(w) PRODUCER AND PRODUCE.—The term 'producer' means the person who manufactures, prepares, compounds, propagates, or processes any pesticide or device. The term 'produce' means to manufacture, prepare, compound, propagate, or process any pesticide or device.

"(x) PROTECT HEALTH AND THE ENVIRONMENT.—The terms 'protect health and the environment' and 'protection of health and the environment' means protection against any injury to man and protection against any substantial adverse effects on environmental values, taking into account the public interest, including benefits from the use of the pesticide.

"(y) REGISTRANT.—The term 'registrant' means a person who has registered any pesticide pursuant to the provisions of this Act.

"(z) REGISTRATION.—The term 'registration' includes reregistration.

"(aa) STATE.—The term 'State' means a State, the District of Columbia, the Commonwealth of Puerto Rico, the Virgin Islands, Guam, the Trust Territory of the Pacific Islands, and American Samoa.

"(bb) SUBSTANTIAL ADVERSE EFFECTS ON THE ENVIRONMENT.—The term 'substantial adverse effects on the environment' means any injury to man or any substantial adverse effects on environmental values, taking into account the public interest, including benefits from the use of the pesticide.

"(cc) WEED.—The term 'weed' means any plant which grows where not wanted.

"SEC. 3. REGISTRATION OF PESTICIDES.

"(a) REQUIREMENT.—Except as otherwise provided by this Act, no person in any State may distribute, sell, offer for sale, hold for sale, ship, deliver for shipment, or receive and (having so received) deliver or offer to deliver, to any person any pesticide which is not registered with the Administrator.

"(b) EXEMPTIONS. A pesticide which is not registered with the Administrator may be transferred if—

"(1) the transfer is from one registered establishment to another registered establishment operated by the same producer solely for packaging at the second establishment or for use as a constituent part of another pesticide produced at the second establishment; or

"(2) the transfer is pursuant to and in accordance with the requirements of an experimental use permit.

"(c) PROCEDURE FOR REGISTRATION.—

"(1) STATEMENT REQUIRED.—Each applicant for registration of a pesticide shall file with the Administrator a statement which includes—

"(A) the name and address of the applicant and of any other person whose name will appear on the labeling;

"(B) the name of the pesticide;

"(C) a complete copy of the labeling of the pesticide, a statement of all claims to be made for it, and any directions for its use;

"(D) if requested by the Administrator, a full description of the tests made and the results thereof upon which the claims are based, except that data submitted in support of an application shall not, without permission of the applicant, be considered by the Administrator in support of any other application for registration;

"(E) the complete formula of the pesticide; and

"(F) a request that the pesticide be classified for general use, for restricted use, or for both.

"(2) DATA IN SUPPORT OF REGISTRATION.—The Administrator shall publish guidelines specifying the kinds of information which will be required to support the registration of a pesticide and shall revise such guidelines from time to time. If thereafter he requires any additional kind of information he shall permit sufficient time for applicants to obtain such additional information. Except as provided by subsection (c) (1) (D) of this section and section 10, within 30 days after the Administrator registers a pesticide under this Act he shall make available to the public the data called for in the registration statement together with such other scientific information as he deems relevant to his decision.

"(3) TIME FOR ACTING WITH RESPECT TO APPLICATION.—The Administrator shall review the data after receipt of the application and shall, as expeditiously as possible, either register the pesticide in accordance with paragraph (5), or notify the applicant of his determination that it does not comply with the provisions of the Act in accordance with paragraph (6).

"(4) NOTICE OF APPLICATION.—The Administrator shall publish in the Federal Register, promptly after receipt of the statement and other data required pursuant to paragraphs (1) and (2), a notice of each application for registration of any pesticide if it contains any new active ingredient or if it would entail a changed use pattern. The notice shall provide for a period of 30 days in which any Federal agency or any other interested person may comment.

"(5) APPROVAL OF REGISTRATION.—The Administrator shall register a pesticide if he determines that, when considered with any restrictions imposed under subsection (d)—

"(A) its composition is such as to warrant the proposed claims for it;

"(B) its labeling and other material required to be submitted comply with the requirements of this Act; and

"(C) it will perform its intended function without substantial adverse effects on the environment.

The Administrator shall not make any lack of essentiality a criterion for denying registration of any pesticide.

"(6) DENIAL OF REGISTRATION.—If the Administrator determines that the requirements of paragraph (5) for registration are not satisfied, he shall notify the applicant for registration of his determination and of his reasons (including the factual basis) therefor, and that, unless the applicant corrects the conditions and notifies the Administrator thereof during the 30-day period beginning with the day after the date on which the applicant receives the notice, the Administrator will refuse to register the pesticide. Whenever the Administrator refuses to register a pesticide, he shall notify the applicant of his decision and of his reasons (including the factual basis) therefor. Upon such notification, the applicant for registration shall have the same remedies as provided for the registrant in section 6.

"(d) CLASSIFICATION OF PESTICIDES.—

"(1) CLASSIFICATION FOR GENERAL USE, RESTRICTED USE, OR BOTH.—

"(A) As a part of the registration of a pesticide the Administrator shall classify it as being for general use or for restricted use, provided that if the Administrator determines that some of the uses for which the pesticide is registered should be for general use and that other uses for which it is registered should be for restricted use, he shall classify it for both general use and restricted use. If some of the uses of the pesticide are classified for general use and other uses are classified for restricted use, the directions relating to its general uses shall be clearly separated and distinguished from those directions relating to its restricted uses.

"(B) If the Administrator determines that the pesticide, when applied in accordance with its directions for use, warnings and cautions and for the uses for which it is registered, or for one or more of such uses, will not cause substantial adverse effects on the environment, he will classify the pesticide, or the particular use or uses of the pesticide to which the determination applies for general use.

"(C) If the Administrator determines that the pesticide, when applied in accordance with its directions for use, warnings and cautions and for the uses for which it is registered, or for one or more of such uses, may cause, without additional regulatory restrictions, substantial adverse effects on the environment, including injury to the applicator, he shall classify the pesticide, or the particular use or uses to which the determination applies, for restricted use.

(i) If the Administrator classifies a pesticide, or one or more uses of such pesticide, for restricted use because of a determination that its acute dermal or inhalation toxicity of the pesticide presents a hazard to the applicator or other persons, the pesticide shall be applied for any use to which the restricted classification applies only by or under the direct supervision of a certified pesticide applicator.

(ii) If the Administrator classifies a pesticide, or one or more uses of such pesticide, for restricted use because of a determination that its use without additional regulatory restriction may cause substantial adverse effect on the environment, the pesticide shall be applied for any use to which the determination applies only by or under the direct supervision of a certified pesticide applicator, or subject to such other restrictions as the Administrator may determine.

"(2) CHANGE IN CLASSIFICATION.—If the Administrator determines that a change in the classification of any use of a pesticide from general use to restricted use is necessary to prevent substantial adverse effects on the environment, he shall notify the registrant of such pesticide of such determination at least 30 days before making the change and shall publish the proposed change in the Federal Register.

"(e) PRODUCTS WITH SAME FORMULATION AND CLAIMS.—Products which have the same formulation, are manufactured by the same person, the labeling of which contains the same claims, and the labels of which bear a designation identifying the product as the same pesticide may be registered as a single pesticide; and additional names and labels shall be added by supplemental statements.

"(f) MISCELLANEOUS.—

"(1) EFFECT OF CHANGE OF LABELING OR FORMULATION.—If the labeling or formulation for a pesticide is changed, the registration shall be amended to reflect such change if the Administrator determines that the change will not violate any provision of this Act.

"(2) Registration not a defense.—In no event shall registration of an article be construed as a defense for the commission of any offense under this Act.

"(3) Authority to consult other Federal agencies.—In connection with consideration of any registration or application for registration under this section, the Administrator may consult with any other Federal agency.

"SEC. 4. USE OF RESTRICTED USE PESTICIDE; CERTIFIED APPLICATORS.

"(a) Certification Procedure.—

"(1) Federal certification.—Subject to paragraph (2), the Administrator shall prescribe standards for the certification of pesticide applicators. Such standards shall provide that to be certified, an individual must be determined to be competent with respect to the use and handling of pesticides, or of the use and handling of the pesticide or class of pesticides covered by such individual's certification.

"(2) State certification.—If any State, at any time, desires to certify pesticide applicators, the Governor of such State shall submit a State plan for such purpose. The Administrator shall approve the plan submitted by any State, or any modification thereof, if such plan in his judgment—

"(A) designates a State agency as the agency responsible for administering the plan throughout the State;

"(B) contains satisfactory assurances that such agency has or will have the legal authority and qualified personnel necessary to carry out the plan;

"(C) gives satisfactory assurances that the State will devote adequate funds to the administration of the plan;

"(D) provides that the State agency will make such reports to the Administrator in such form and containing such information as the Administrator may from time to time require; and

"(E) contains satisfactory assurances that State standards for the certification of pesticide applicators conform with those standards prescribed by the Administrator under paragraph (1).

"(b) STATE PLANS.—If the Administrator rejects a plan submitted under this paragraph, he shall afford the State submitting the plan due notice and opportunity for hearing before so doing. If the Administrator approves a plan submitted under this paragraph, then such State shall certify pesticide applicators with respect to such State.

"SEC. 5. EXPERIMENTAL USE PERMITS.

"(a) Issuance.—Any person may apply to the Administrator for an experimental use permit for a pesticide. The Administrator may issue an experimental use permit if he determines that the applicant needs such permit in order to accumulate information necessary to register a pesticide under section 3. An application for an experimental use permit may be filed at the time of or before or after an application for registration is filed.

"(b) Temporary Tolerance Level.—If the Administrator determines that the use of a pesticide may reasonably be expected to result in any residue on or in food or feed, he may establish a temporary tolerance level for the residue of the pesticide before issuing the experimental use permit.

"(c) Use Under Permit.—Use of a pesticide under an experimental use permit shall be under the supervision of the Administrator, and shall be subject to such terms and conditions and be for such period of time as the Administrator may prescribe in the permit.

"(d) Studies.—When any experimental use permit is issued for a pesticide containing any chemical or combination of chemicals which has not been included in any previously registered pesticide, the Administrator may specify that studies be conducted to detect whether the use of the pesticide under the permit may cause substantial adverse effects on the environment. All results of such studies shall be reported to the Administrator before such pesticide may be registered under section 3.

"(c) REVOCATION.—The Administrator may revoke any experimental use permit, at any time, if he finds that its terms or conditions are being violated, or that its terms and conditions are inadequate to avoid substantial adverse effects on the environment.

"SEC. 6. ADMINISTRATIVE REVIEW; SUSPENSION.

"(a) CANCELLATION AFTER FIVE YEARS.—

"(1) PROCEDURE.—The Administrator shall cancel the registration of any pesticide at the end of the five-year period which begins on the date of its registration (or at the end of any five-year period thereafter) unless the registrant, before the end of such period, requests in accordance with regulations prescribed by the Administrator that the registration be continued in effect.

"(2) INFORMATION.—If at any time after the registration of a pesticide the registrant has additional factual information regarding substantial adverse effects on the environment of the pesticide, he shall submit such information to the Administrator.

"(b) CANCELLATION AND CHANGE IN CLASSIFICATION.—If the Administrator determines that registration of a pesticide should be canceled or that the classification of a pesticide should be changed, he shall notify the registrant of such notice, the registrant may, within 30 days (A) registration or change the classification and of his reasons (including the factual basis) therefor in writing. Upon receipt of such notice, the registrant may, within 30 days (A) make the necessary corrections and so notify the Administrator, or (B) file objections and request a public hearing. If the registrant does not take any such action, the notice shall, at the end of 30 days from its receipt by the registrant, constitute a final order of cancellation or change in classification. If the registrant files objections and requests a public hearing, the order of cancellation or change in classification may only be issued after completion of such proceeding.

"(c) SUSPENSION.—

"(1) ORDER.—If the Administrator determines that such action is necessary to prevent an imminent hazard during the time required for cancellation proceedings, he may, by order, suspend the registration of the pesticide immediately. No order of suspension may be issued unless at the same time the Administrator issues notices of his intention to cancel the registration of the pesticide. Any remedy elected by the registrant under section 6 (a) shall be held as expeditiously as possible.

"(2) DURATION OF ORDER.—Any suspension order shall remain in effect only until 90 days after the completion of the administrative remedies provided for under section 6 (a) or until the Administrator issues his final order either canceling or denying cancellation of the registration, whichever is sooner.

"(3) JUDICIAL REVIEW.—Any order of suspension shall be subject to immediate review in all actions by the registrant in an appropriate district court, solely to determine whether the order of suspension was arbitrary, capricious or an abuse of discretion, or whether the order was issued in accordance with the procedures established by law. This action may be maintained simultaneously with any administrative review proceeding under section 6.

"(d) SCIENTIFIC REVIEW.—Whenever application for registration is refused or a registration is cancelled or suspended, the registrant within 30 days after service of notice of such action may file a petition requesting that the matter

"(d) PUBLIC HEARINGS AND SCIENTIFIC REVIEW.—In the event a hearing is requested pursuant to subsection

(a) or (d) or determined upon by the Administrator pursuant to subsection (d), such hearing shall be held after due notice for the purpose of receiving evidence relevant and material to the issues raised by the objections filed by the applicant or other interested parties, or to the issues stated by the Administrator, if the hearing is called by the Administrator rather than by the filing of objections. Upon a showing of relevance and reasonable scope of evidence sought by any party to a public hearing, the Hearing Examiner shall issue a subpena to compel testimony from any person. Upon the request of any party or when in the hearing officer's judgment it is necessary or desirable, the hearing officer shall refer to a Committee of the National Academy of Sciences all relevant questions of scientific fact arising in the course of the public hearing. The Committee of the National Academy of Sciences shall report in writing to the officer within 60 days on these questions of scientific fact. The report shall be made public and shall be considered as part of the hearing record. The Administrator shall enter into appropriate arrangements with the National Academy of Sciences to assure an objective and competent scientific review of the questions presented to Committees of the Academy and to provide such other scientific advisory services as may be required by the Administrator for carrying out the purposes of this Act. The Hearing Examiner shall be guided by the principles of the Federal

Rules of Civil Procedure in making any order for the protection of the witness and shall order the payment of reasonable fees and expenses as a condition to requiring his testimony. On contest, the subpena may be enforced by an appropriate United States District Court in accordance with the principles stated herein and the Administrative Procedure Act. As soon as practicable after completion of the hearing but not later than 90 days thereafter, the Administrator shall evaluate the data and reports before him and issue an order either revoking his notice of intention issued pursuant to this section, or shall issue an order either cancelling the registration, changing the classification, denying the registration, or requiring modification of the labeling or packaging of the article. Such order shall be based only on substantial evidence of record of such hearing and shall set forth detailed findings of fact upon which the order is based.

"(c) JUDICIAL REVIEW.—Final orders of the Administrator under this section shall be subject to judicial review pursuant to section 16.

"SEC. 7. REGISTRATION OF ESTABLISHMENTS.

"(a) REQUIREMENT.—No person shall produce any pesticide or device subject to this Act in any State unless the establishment in which it is produced is registered with the Adminstrator. The application for registration of any establishment shall include the name and address of the establishment and of the producer who operates such establishment.

"(b) REGISTRATION.—Whenever the Administrator receives an application under subsection (a), he shall register the establishment and assign it an establishment number.

"(c) INFORMATION REQUIRED.—

"(1) Any producer operating an establishment registered under this section shall inform the Administrator within 30 days after it is registered of the types and amounts of pesticides and devices—

"(A) which he is currently producing;

"(B) which he has produced during the past year; and

"(C) which he has sold or distributed during the past year.

The information required by this paragraph shall be kept current and submitted to the Administrator annually as required under such regulations as the Administrator may prescribe.

"(2) Any such producer shall, upon the request of the Administrator for the purpose of issuing a stop sale order pursuant to section 13, inform him of the name and address of any recipient of any pesticide produced in any registered establishment which he operates.

"(d) CONFIDENTIAL RECORDS AND INFORMATION.—

Any information submitted to the Administrator pursuant to subsection (c) shall be considered confidential and shall be subject to the provisions of section 10.

"SEC. 8. BOOKS AND RECORDS.

"(a) REQUIREMENT.—The Administrator may prescribe regulations requiring producers to maintain such records with respect to their operations and the pesticides and devices produced as he determines are necessary for the effective enforcement of this Act. No records required under this subsection shall extend to financial data, sales data other than shipment data, pricing data, personnel data, and research data (other than data relating to registered pesticides or to a pesticide for which an application for registration has been filed).

"(b) INSPECTION.—For the purposes of enforcing the provisions of this Act, any producer, distributor, carrier, dealer, or any other person who sells or offers for sale, delivers or offers for delivery any pesticide or device subject to this Act, shall, upon request of any officer or employee of the Environmental Protection Agency or of any State or political subdivision, duly designated by the Administrator, furnish or permit such person at all reasonable times to have access to, and to copy: (1) all records showing the delivery, movement, or holding of such pesticide or device, including the quantity, the date of shipment and receipt, and the name of the consignor and consignee; or (2) in the event of the inability of any person to produce records containing such information, all other records and information relating to such delivery, movement, or holding of the pesticide or devices. Any inspection with respect to any records and information referred to in this subsection shall not extend to financial data, sales data other than shipment data, pricing data, personnel data, and research data (other than data relating to registered pesticides or to a pesticide for which an application for registration has been filed).

"SEC. 9. INSPECTION OF ESTABLISHMENTS, ETC.

"(a) IN GENERAL.—For purposes of enforcing the provisions of this Act, officers or employees duly designated by the Administrator are authorized—

"(1) to enter, at reasonable times, any establishment; and

"(2) to inspect and obtain samples of any pesticides or devices, packaged, labeled, and released for shipment, and samples of any containers or labeling for such pesticides or devices.

Before undertaking such inspection, the officers or employees must present to the owner, operator, or agent in charge of the establishment, appropriate credentials and a written statement as to the reason for the inspection, including a statement as to whether a violation of the law is suspected.

If no violation is suspected, an alternate and sufficient reason shall be given in writing. Each such inspection shall be commenced and completed with reasonable promptness. If the officer or employee obtains any samples, prior to leaving the premises, he shall give to the owner, operator, or agent in charge a receipt describing the samples obtained and, if requested, a portion of each such sample equal in volume or weight to the portion retained. If an analysis is made of such samples, a copy of the results of such analysis shall be furnished promptly to the owner, operator, or agent in charge.

"(b) WARRANTS.—For purposes of enforcing the provisions of this Act and upon a showing to an officer or court of competent jurisdiction that there is reason to believe that the provisions of this Act have been violated, officers or employees duly designated by the Administrator are empowered to obtain and to execute warrants authorizing—

"(1) entry for the purpose of this section;

"(2) inspection and reproduction of all records showing the quantity, date of shipment, and the name of consignor and consignee of any illegal pesticide or device found in the establishment and in the event of the inability of any person to produce records containing such information, all other records and information relating to such delivery, movement, or holding of the pesticide or device; and

"(3) the seizure of any pesticide or device which is in violation of this Act.

"(c) ENFORCEMENT.—

"(1) CERTIFICATION OF FACTS TO ATTORNEY GENERAL.—The examination of pesticides or devices shall be made in the Environmental Protection Agency or elsewhere as the Administrator may designate for the purpose of determining from such examinations whether they comply with the requirements of this Act. If it shall appear from any such examination that they fail to comply with the requirements of this Act, the Administrator shall cause notice to be given to the person against whom criminal proceedings are contemplated. Any person so notified shall be given an opportunity to present his views, either orally or in writing, with regard to such contemplated proceedings, and if in the opinion of the Administrator it appears that the provisions of this Act have been violated by such person, then the Administrator shall certify the facts to the Attorney General, with a copy of the results of the analysis or the examination of such pesticide for the institution of a criminal proceeding pursuant to section 16, when the Administrator determines that such action will be sufficient to effectuate the purposes of this Act.

"(2) NOTICE NOT REQUIRED.—The notice of contemplated proceedings and opportunity to present views set forth in this subsection are not prerequisites to the institution of any proceeding by the Attorney General.

"(3) WARNING NOTICES.—Nothing in this Act shall be construed as requiring the Administrator to institute proceedings for prosecution of minor violations of this Act whenever he believes that the public interest will be adequately served by a suitable written notice of warning.

"SEC. 10. PROTECTION OF TRADE SECRETS AND OTHER INFORMATION.

"(a) IN GENERAL.—In submitting data required by this Act, the applicant may (1) clearly mark any portions thereof which in his opinion are trade secrets or commercial or financial information, and (2) submit such marked material separately from other material required to be submitted under this Act.

"(b) DISCLOSURE.—Notwithstanding any other provision of this Act, the Administrator shall not make public information which in his judgment contains or relates to trade secrets or commercial or financial information obtained from a person and privileged or confidential, except that, when necessary to carry out the provisions of this Act, information relating to formulas of products acquired by authorization of this Act may be revealed to any Federal agency consulted and may be revealed at a public hearing or in findings of fact issued by the Administrator.

"SEC. 11. STANDARDS APPLICABLE TO PESTICIDE APPLICATORS.

"(a) In General.—No regulations prescribed by the Administrator for carrying out the provisions of this Act shall require any private pesticide applicator to maintain any records or file any reports or other documents.

"(b) Separate Standards.—When establishing or approving standards for licensing or certification, the Administrator shall establish separate standards for commercial and private applicators.

"SEC. 12. UNLAWFUL ACTS.

"(a) In General.—

"(1) Except as provided by subsection (b), it shall be unlawful for any person in any State to distribute, sell, offer for sale, hold for sale, ship, deliver for shipment, or receive and (having so received) deliver or offer to deliver, to any person—

"(A) any pesticide which is not registered under section 3;

"(B) any registered pesticide if any claims made for it as a part of its distribution or sale substantially differ from any claims made for it as a part of the statement required in connection with its registration under section 3;

"(C) any registered pesticide the composition of which differs at the time of its distribution or sale from its composition as described in the statement required in connection with its registration under section 3;

"(D) any pesticide which has not been colored or discolored pursuant to the provisions of section 25(c)(5);

"(E) any pesticide which is adulterated or misbranded; or

"(F) any device which is misbranded.

"(2) It shall be unlawful for any person—

"(A) to detach, alter, deface, or destroy, in whole or in part, any labeling required under this Act;

"(B) to refuse to keep any records required pursuant to section 8, or to refuse to allow the inspection of any records or establishment pursuant to section 8 or 9, or to refuse to allow an officer or employee of the Environmental Protection Agency to take a sample of any pesticide pursuant to section 9;

"(C) to give a guaranty or undertaking provided for in subsection (b) which is false in any particular, except that a person who receives and relies upon a guaranty authorized under subsection (b) may give a guaranty to the same effect, which guaranty shall contain, in addition to his own name and address, the name and address of the person residing in the United States from whom he received the guaranty or undertaking;

"(D) to use for his own advantage or to reveal, other than to the Administrator, or officials or employees of the Environmental Protection Agency or other Federal executive agencies, or to the courts, or to physicians, pharmacists, and other qualified persons, needing such information for the performance of their duties, in accordance with such directions as the Administrator may prescribe, any information acquired by authority of this Act which is confidential under this Act;

"(E) who is a registrant, wholesaler, dealer, retailer, or other distributor to advertise a product registered under this Act for restricted use without giving the classification of the product assigned to it under section 3;

"(F) to make available for use, or to use, any registered pesticide classified for restricted use for some or all purposes other than in accordance with section 3(d) and any regulations thereunder;

"(G) to use any registered pesticide in a manner inconsistent with its labeling;

"(H) to use any pesticide which is under an experimental use permit contrary to the provisions of such permit;

"(I) to violate any order issued under section 13;

"(J) to violate any suspension order issued under section 6;

"(K) to violate any cancellation of registration of a pesticide under section 6;

"(L) who is a producer to violate any of the provisions of section 7;

"(M) to knowingly falsify all or part of any application for registration, application for experimental use permit, any information submitted to the Administrator pursuant to section 7, any records required to be maintained pursuant to section 8, any report filed under this Act, or any information marked as confidential and submitted to the Administrator under any provision of this Act;

"(N) who is a registrant, wholesaler, dealer.

retailer, or other distributor to fail to file reports required by this Act; or

"(O) to add any substance to, or take any substance from any pesticide in a manner that may defeat the purpose of this Act.

"(b) EXEMPTIONS.—The penalties provided for a violation of paragraph (1) of subsection (a) shall not apply to—

"(1) any person who establishes a guaranty signed by, and containing the name and address of, the registrant or person residing in the United States from whom he purchased and received in good faith the pesticide in the same unbroken package, to the effect that the pesticide was lawfully registered at the time of sale and delivery to him, and that it complies with the other requirements of this Act, and in such case the guarantor shall be subject to the penalties which would otherwise attach to the person holding the guaranty under the provision of this Act;

"(2) any carrier while lawfully shipping, transporting, or delivering for shipment any pesticide or device, if such carrier upon request of any officer or employee duly designated by the Administrator shall permit such officer or employee to copy all of its records concerning such pesticide or device;

"(3) any public official while engaged in the performance of his official duties;

"(4) any person using or possessing any pesticide as provided by an experimental use permit in effect with respect to such pesticide and such use or possession; or

"(5) any person who ships a substance or mixture of substances being put through tests in which the purpose is only to determine its value for pesticide purposes or to determine its toxicity or other properties and from which the user does not expect to receive any benefit in pest control from its use.

"**SEC. 13. STOP SALE, USE, REMOVAL AND SEIZURE.**

"(a) STOP SALE, ETC., ORDERS.—Whenever any pesticide or device is found by the Administrator in any State and there is reason to believe on the basis of inspection or tests that such pesticide or device is in violation of any of the provisions of this Act, or that such pesticide or device has been or is intended to be distributed or sold in violation of any such provisions, or when the registration of the pesticide or device has been canceled by a final order or has been suspended, the Administrator may issue a written or printed 'stop sale, use, or removal' order to any person who owns, controls, or has custody of such pesticide or device, and after receipt of such order no person shall sell, use, or remove the pesticide or device described in the order except in accordance with the provisions of the order.

"(b) SEIZURE.—Any pesticide or device that is being transported or, having been transported, remains unsold or in original unbroken packages, or that is sold or offered for sale in any State, or that is imported from a foreign country, shall be liable to be proceeded against in any district court in the district where it is found and seized for confiscation by a process in rem for condemnation if—

"(1) in the case of a pesticide—

"(A) it is adulterated or misbranded;

"(B) it is not registered pursuant to the provisions of section 3;

"(C) its labeling fails to bear the information required by this Act;

"(D) it is not colored or discolored and such coloring or discoloring is required under this Act; or

"(E) any of the claims made for it or any of the directions for its use differ in substance from the representations made in connection with its registration;

"(2) in the case of a device, it is misbranded; or

"(3) in the case of a pesticide or device, when used in accordance with the requirements imposed under this Act and as directed by the labeling, it nevertheless causes substantial adverse effects on the environment. In the case of a plant regulator, defoliant, or desiccant, used in accordance with the label claims and recommendations, physical or physiological effects on plants or parts thereof shall not be deemed to be injury, when such effects are the purpose for which the plant regulator, defoliant, or desiccant was applied.

"(c) DISPOSITION AFTER CONDEMNATION.—If the pesticide or device is condemned it shall, after entry of the decree, be disposed of by destruction or sale as the court may direct and the proceeds, if sold, less the court costs, shall be paid into the Treasury of the United States, but the pesticide or device shall not be sold contrary to the provisions of this Act or the laws of the jurisdiction in which it is sold: *Provided*, That upon the payments of the costs of the condemnation proceedings and the execution and delivery of a good and sufficient bond conditioned that the pesticide or device shall not be sold or otherwise disposed of contrary to the provisions of the Act or the laws of any State in which sold, the court may direct that such pesticide or device be delivered to the owner thereof. The proceedings of such condemnation cases shall conform, as near as may be, to the proceedings in admiralty, except that either party may demand trial by jury of any issue of fact joined in any case, and all such proceedings shall be at the suit of and in the name of the United States.

"(d) Court Costs, Etc.—When a decree of condemnation is entered against the pesticide or device, court costs and fees, storage, and other proper expenses shall be awarded against the person, if any, intervening as claimant of the pesticide or device.

"SEC. 14. PENALTIES.

"(a) Civil Penalties.—

"(1) In General.—Any registrant, commercial pesticide applicator, wholesaler, dealer, retailer, or other distributor who violates any provision of this Act may be assessed a civil penalty by the Administrator of not more than $5,000 for each offense.

"(2) Private Pesticide Applicator.—Any private pesticide applicator who violates any provision of this Act subsequent to receiving a written warning from the Administrator or following a citation for a prior violation, may be assessed a civil penalty by the Administrator of not more than $1,000 for each offense.

"(3) Hearing.—No civil penalty shall be assessed unless the person charged shall have been given notice and opportunity for a hearing on such charge in the county, parish, or incorporated city of the residence of the person charged. In determining the amount of the penalty the Administrator shall consider the appropriateness of such penalty to the size of the business of the person charged, the effect on the person's ability to continue in business, and the gravity of the violation.

"(4) REFERENCES TO ATTORNEY GENERAL.—In case of inability to collect such civil penalty or failure of any person to pay all, or such portion of such civil penalty as the Administrator may determine, the Administrator shall refer the matter to the Attorney General, who shall recover such amount by action in the appropriate United States district court.

"(b) CRIMINAL PENALTIES.—

"(1) IN GENERAL.—Any registrant, commercial pesticide applicator, wholesaler, dealer, retailer, or other distributor who knowingly violates any provision of this Act shall be guilty of a misdemeanor and shall on conviction be fined not more than $25,000, or imprisoned for not more than one year, or both.

"(2) PRIVATE PESTICIDE APPLICATOR.—Any private pesticide applicator who knowingly violates any provision of this Act shall be guilty of a misdemeanor and shall on conviction be fined not more than $1,000, or imprisoned for not more than 30 days, or both.

"(3) DISCLOSURE OF INFORMATION.—Any person, who, with intent to defraud, uses or reveals information relative to formulas of products acquired under the authority of section 3, shall be fined not more than $10,000, or imprisoned for not more than three years, or both.

"(4) ACTS OF OFFICERS, AGENTS, ETC.—When construing and enforcing the provisions of this Act, the act, omission, or failure of any officer, agent, or other person acting for or employed by any person shall in every case be also deemed to be the act, omission, or failure of such person as well as that of the person employed.

"SEC. 15. INDEMNITIES.

"(a) REQUIREMENT.—If—

"(1) the Administrator notifies a registrant that he has suspended the registration of a pesticide because such action is necessary to prevent an imminent hazard;

"(2) the registration of the pesticide is canceled as a result of a final determination that the use of such pesticide will create an imminent hazard; and

"(3) any person who owned any quantity of such pesticide immediately before the notice to the registrant under paragraph (1) suffered losses by reason of suspension or cancellation of the registration,

the Administrator shall make an indemnity payment to such person.

"(b) AMOUNT OF PAYMENT.—

"(1) IN GENERAL.—The amount of the indemnity payment under subsection (a) to any person shall be determined on the basis of the cost of the pesticide owned by such person immediately before the notice to the registrant referred to in subsection (a) (1); except that in no event shall an indemnity payment to any person exceed the fair market value of the pesticide owned by such person immediately before the notice referred to in subsection (a) (1).

"(2) SPECIAL RULE.—Notwithstanding any other provision of this Act, the Administrator may provide a reasonable time for use or other disposal of such pesticide. In determining the quantity of any pesticide for which indemnity shall be paid under this subsection, proper adjustment shall be made for any pesticide used or otherwise disposed of by such owner.

"SEC. 16. ADMINISTRATIVE PROCEDURE; JUDICIAL REVIEW.

"(a) APPLICATION OF ADMINISTRATIVE PROCEDURE ACT.—Except as provided by subsection (b), subchapter II of chapter 5 of title 5 of the United States Code (sec. 551 and following, relating to administrative procedure) and chapter 7 of title 5 of the United States Code (sec. 701 and following, relating to judicial review) apply in respect of rules, rule making, orders, adjudication, licensing, sanctions, agency proceedings, and agency actions (as such terms are used in subchapter II of chapter 5 and in chapter 7 of title 5 of the United States Code).

"(b) JUDICIAL REVIEW.—In the case of actual controversy as to the validity of any order issued by the Administrator following a public hearing, any party at interest may obtain judicial review by filing in the United States court of appeals for the circuit wherein such person resides or has a place of business, within 60 days after the entry of such order, a petition praying that the order be set aside in whole or in part. A copy of the petition shall be forthwith transmitted by the clerk of the court to the Administrator or any officer designated by him for that purpose, and thereupon the Administrator shall file in the court the record of the proceedings on which he based his order, as provided in section 2112 of title 28, United States Code. Upon the filing of such petition the court shall have exclusive jurisdiction to affirm or set aside the order complained of in whole or in part. The court shall consider all evidence of record. The order of the Administrator shall be sustained if it is supported by substantial evidence when considered on the record as a whole. The judgment of the court affirming or setting aside, in whole or in part, any order under this section shall be final, subject to review by the Supreme Court of the

United States upon certiorari or certification as provided in section 1254 of title 28 of the United States Code. The commencement of proceedings under this section shall not, unless specifically ordered by the court to the contrary, operate as a stay of an order. The court shall advance on the docket and expedite the disposition of all cases filed therein pursuant to this section.

"(c) JURISDICTION OF DISTRICT COURTS.—The district courts of the United States are vested with jurisdiction specifically to enforce, and to prevent and restrain violations of, this Act.

"(d) NOTICE OF JUDGMENTS.—The Administrator shall, by publication in such manner as he may prescribe, give notice of all judgments entered in actions instituted under the authority of this Act.

"SEC. 17. IMPORTS AND EXPORTS.

"(a) PESTICIDES AND DEVICES INTENDED FOR EXPORT.—Notwithstanding any other provision of this Act, no pesticide or device shall be deemed in violation of this Act when intended solely for export to any foreign country and prepared or packed according to the specifications or directions of the foreign purchaser.

"(b) CANCELLATION NOTICES FURNISHED TO FOREIGN GOVERNMENTS.—Whenever a cancellation of the registration of a pesticide becomes effective, the Administrator shall transmit through the State Department copies of each notice of cancellation of a registration of a pesticide to the governments of other countries and to appropriate international agencies.

"(c) IMPORTATION OF PESTICIDES AND DEVICES.—The Secretary of the Treasury shall notify the Administrator of the arrival of pesticides and devices and shall deliver to the Administrator, upon his request, samples of pesticides or devices which are being imported into the United States, giving notice to the owner or consignee, who may appear before the Administrator and have the right to introduce testimony. If it appears from the examination of a sample that it is adulterated, or misbranded or otherwise violates the provisions set forth in this Act, or is otherwise injurious to health or the environment. the pesticide or device may be refused admission, and the Secretary of the Treasury shall refuse delivery to the consignee and shall cause the destruction of any pesticide or device refused delivery which shall not be exported by the consignee within 90 days from the date of notice of such refusal under such regulations as the Secretary of the Treasury may prescribe: *Provided*, That the Secretary of the Treasury may deliver to the consignee such pesticide or device pending examination and decision in the matter on execution of bond for the amount of the full invoice value of such pesticide or device, together with the duty thereon, and on refusal to return such pesticide or device for any cause to the custody of the Secretary of the Treasury, when demanded, for the purpose of excluding them from the country, or for any other purpose, said consignee shall forfeit the full amount of said bond: *And provided further*, That all charges for storage, cartage, and labor on pesticide or device which are refused admission or delivery shall be paid by the owner or consignee, and in default of such payment shall constitute a lien against any future importation made by such owner or consignee.

"(d) COOPERATION IN INTERNATIONAL EFFORTS.—The Administrator shall, in cooperation with the Department of State and any other appropriate Federal agency, participate and cooperate in any international efforts to develop improved pesticide research and regulations.

"(e) REGULATIONS.—The Secretary of the Treasury, in consultation with the Administrator, shall prescribe regulations for the enforcement of this section.

"SEC. 18. EXEMPTION OF FEDERAL AGENCIES.

"The President by executive order may exempt any Federal Agency from any provision or all provisions of this Act if he determines that emergency conditions exist which require such exemption.

"SEC. 19. DISPOSAL AND TRANSPORTATION.

"(a) PROCEDURES.—The Administrator shall, after consultation with other interested Federal agencies, establish procedures and regulations for the disposal or storage of packages and containers of pesticides and for disposal or storage of excess amounts of such pesticides, and accept at convenient locations for safe disposal a pesticide the registration of which is canceled under section 6(c) if requested by the owner of the pesticide.

"(b) ADVICE TO SECRETARY OF TRANSPORTATION.—The Administrator shall provide advice and assistance to the Secretary of Transportation with respect to his functions relating to the transportation of hazardous materials under the Department of Transportation Act (49 U.S.C. 1657), the Transportation of Explosives Act (18 U.S.C. 831-835), the Federal Aviation Act of 1958 (49 U.S.C. 1421-1430, 1472 H), and the Hazardous Cargo Act (46 U.S.C. 170, 375, 416).

"SEC. 20. RESEARCH AND MONITORING.

"(a) RESEARCH.—The Administrator shall undertake research, including research by grant or contract with other Federal agencies, universities, or others as may be necessary to carry out the purposes of this Act, and he shall give priority to research to develop biologically integrated alternatives for pest control. The Administrator shall also take care to insure that such research does not duplicate research being undertaken by any other Federal agency.

"(b) NATIONAL MONITORING PLAN.—The Administrator shall formulate and periodically revise, in cooperation with other Federal, State, or local agencies, a national plan for monitoring pesticides.

"(c) MONITORING.—The Administrator shall undertake such monitoring activities, including but not limited to monitoring in air, soil, water, man, plants, and animals, as may be necessary for the implementation of this Act and of the national pesticide monitoring plan. Such activities shall be carried out in cooperation with other Federal, State, and local agencies.

"SEC. 21. SOLICITATION OF PUBLIC COMMENTS.

"In addition to any other authority relating to public hearings and solicitation of views, in connection with the suspension or cancellation of a pesticide registration or any other actions authorized under this Act, the Administrator may, at his discretion, solicit the views of all interested persons, either orally or in writing, and seek such advice from scientists, farmers, farm organizations, and other qualified persons as he deems proper.

"SEC. 22. DELEGATION AND COOPERATION.

"(a) DELEGATION.—All authority vested in the Administrator by virtue of the provisions of this Act may with like force and effect be executed by such employees of the Environmental Protection Agency as the Administrator may designate for the purpose.

"(b) COOPERATION.—The Administrator shall cooperate with the Department of Agriculture, any other Federal agency, and any appropriate agency of any State or any political subdivision thereof, in carrying out the provisions of this Act, and in securing uniformity of regulations.

"SEC. 23. STATE COOPERATION, AID, AND TRAINING.

"(a) COOPERATIVE AGREEMENTS.—The Administrator is authorized to enter into cooperative agreements with States—

"(1) to delegate to any State the authority to cooperate in the enforcement of the Act through the use of its personnel or facilities, to train personnel of the State to cooperate in the enforcement of this Act, and to assist States in implementing cooperative enforcement programs through grants-in-aid; and

"(2) to assist State agencies in developing and administering State programs for training and certification of pesticide applicators consistent with the standards which he prescribes.

"(b) CONTRACTS FOR TRAINING.—In addition, the Administrator is authorized to enter into contracts with Federal or State agencies for the purpose of encouraging the training of certified pesticide applicators.

"SEC. 24. AUTHORITY OF STATES.

"(a) A State may regulate the sale or use of any pesticide or device in the State, but only if and to the extent the regulation does not permit any sale or use prohibited by this Act or restrict by license or permit the use of a pesticide registered for general use;

"(b) such State shall not impose or continue in effect any requirements for labeling and packaging in addition to or different from those required pursuant to this Act; and

"(c) a State may assist the Administrator in the registration of pesticides formulated for intrastate distribution to meet specific local needs if that State is certified by the Administrator as capable of exercising adequate controls.

"SEC. 25. AUTHORITY OF ADMINISTRATOR.

"(a) REGULATIONS.—The Administrator is authorized to prescribe regulations to carry out the provisions of this Act. Such regulations shall take into account the difference in concept and usage between various classes of pesticides.

"(b) EXEMPTION OF PESTICIDES.—The Administrator may exempt from the requirements of this Act by regulation any pesticide which he determines either (1) to be adequately regulated by another Federal agency, or (2) to be of a character which is unnecessary to be subject to this Act in order to carry out the purposes of this Act.

"(c) OTHER AUTHORITY.—The Administrator, after notice and opportunity for hearing, is authorized—

"(1) to declare a pest any form of plant or animal life (other than man and other than bacteria, virus, and other micro-organisms on or in living man or other living animals) which is injurious to health or the environment;

"(2) to determine any pesticide which contains any substance or substances in quantities highly toxic to man;

"(3) to establish standards (which shall be consistent with those established under the authority of the Poison Prevention Packaging Act (Public Law 91-601)) with respect to the package, container, or wrapping in which a pesticide or device is enclosed for use or consumption, in order to protect children and adults from serious injury or illness resulting from accidental ingestion or contact with pesticides or devices regulated by this Act as well as to accomplish the other purposes of this Act;

"(4) to specify that any class of devices shall be subject to this Act if he determines that the application of this Act in respect of such class is necessary to effectuate the purposes of this Act;

"(5) to prescribe regulations requiring any pesticide to be colored or discolored if he determines that such requirement is feasible and is necessary for the protection of health and the environment; and

"(6) to determine and establish suitable names to be used in the ingredient statement.

"SEC. 26. SEVERABILITY.

"If any provision of this Act or the application thereof to any person or circumstance is held invalid, the invalidity shall not affect other provisions or applications of this Act which can be given effect without regard to the invalid provision or application, and to this end the provisions of this Act are severable.

"SEC. 27. AUTHORIZATION FOR APPROPRIATIONS.

"There is authorized to be appropriated such sums as may be necessary to carry out the provisions of this Act for each fiscal year ending June 30, 1972, June 30, 1973, and June 30, 1974. The amounts authorized to be appropriated for any fiscal year ending after June 30, 1974, shall be the sums hereafter provided by law."

AMENDMENTS TO OTHER ACTS

SEC. 3. The following Acts are amended by striking out the terms "economic poisons" and "an economic poison" wherever they appear and inserting in lieu thereof "pesticides" and "a pesticide" respectively:

(1) The Federal Hazardous Substances Act, as amended (15 U.S.C. 1261 et seq.);

(2) The Poison Prevention Packaging Act, as amended (15 U.S.C. 1471 et seq.); and

(3) The Federal Food, Drug, and Cosmetic Act, as amended (21 U.S.C. 301 et seq.).

EFFECTIVE DATES OF PROVISIONS OF ACT

SEC. 4. (a) Except as otherwise provided in the Federal Insecticide, Fungicide, and Rodenticide Act, as amended by this Act, and as otherwise provided by this section, the amendments made by this Act shall take effect at the close of the date of the enactment of this Act, provided if regulations are necessary for the implementation of any provision that becomes effective on the date of enactment, such regulations shall be promulgated and shall become effective within 90 days from the date of enactment of this Act.

(b) The provisions of the Federal Insecticide, Fungicide, and Rodenticide Act and the regulations thereunder as such existed prior to the enactment of this Act shall remain in effect until superceded by the amendments made by this Act and regulations thereunder: *Provided*, That all provisions made by these amendments and all regulations thereunder shall be effective within four years after the enactment of this Act.

(c) (1) Two years after the enactment of this Act the Administrator shall have promulgated regulations providing for the registration and classification of pesticides under the provisions of this Act and thereafter shall register all new applications under such provisions.

(2) After two years but within four years after the enactment of this Act the Administrator shall register and reclassify pesticides registered under the provisions of the Federal Insecticide, Fungicide, and Rodenticide Act prior to the effective date of the regulations promulgated under subsection (c) (1).

(3) Any requirements that a pesticide be registered for use only by a certified pesticide applicator shall not be effective until four years from the date of enactment of this Act.

(4) A period of four years from date of enactment shall be provided for certification of pesticide applicators.

(A) One year after the enactment of this Act the Administrator shall have prescribed the standards for the certification of pesticide applicators.

(B) Within three years after the enactment of this Act each State desiring to certify pesticide applicators shall submit a State plan to the Administrator for the purpose provided by section 4(b).

(C) As promptly as possible but in no event more than one year after submission of a State plan, the Administrator shall approve the State plan or disapprove it and indicate the reasons for disapproval. Consideration of plans resubmitted by States shall be expedited.

(5) One year after the enactment of this Act the Administrator shall have promulgated and shall make effective regulations relating to the registration of establishments, permits for experimental use, and the keeping of books and records under the provisions of this Act.

(d) No person shall be subject to any criminal or civil penalty imposed by the Federal Insecticide, Fungicide, and Rodenticide Act, as amended by this Act, for any act (or failure to act) occurring before the expiration of 60 days after final regulations (relating to such penalty) under the Federal Insecticide, Fungicide, and Rodenticide Act, as amended, are published in the Federal Register.

(e) For purposes of determining any criminal or civil penalty or liability to any third person in respect of any act or omission occurring before the expiration of the periods referred to in this section, the Federal Insecticide, Fungicide, and Rodenticide Act shall be treated as continuing in effect as if this Act had not been enacted.

PENNSYLVANIA LAWS

Library references: P.L.E. Nuisance § 63.

Cross References

Analyses, Department of Agriculture, see section 446 of Title 71, State Government.

Federal statutes, see 7 U.S.C.A. § 135 et seq.

Ground limestone and related products, see sections 131—1 to 131—9 of this title.

Pharmacy Act, poisons, application, see section 390—9(j) of Title 63, Professions and Occupations.

§§ 101–110. Repealed. 1957, June 5, P.L. 248, No. 125, § 13

Historical Note

These sections were derived from the act of 1907, May 29, P.L. 309; act of 1917, May 17, P.L. 224; act of 1925, April 4, P.L. 136; act of 1931, April 24, P.L. 44, No. 35, § 1; act of 1939, May 25, P.L. 221, §§ 1 and 2; and act of 1941, June 12, P.L. 124, No. 64, §§ 1 and 2. The sections related to insecticides and fungicides. The subject matter is now covered by sections 111.1 to 111.13 of this title.

Pharmacy Act

Section 9(j) of the Pharmacy Act of 1961 (section 390—9 (j) of Title 63, Professions and Occupations) provides: "(j) The provisions of this section [Title 63, § 390—9] shall not apply with respect to any poisons regulated and controlled by the Secretary of Agriculture pursuant to the Pennsylvania Pesticide Act of 1957 [section 111.1 et seq. of this title] nor with respect to any poisons present in commercial feeds as defined and regulated by the Commercial Feeds Act of 1956, May 29, P.L. (1955) 1788 [section 57.1 et seq. of this title]."

§ 111.1 Short title

This act shall be known and may be cited as the "Pennsylvania Pesticide Act of 1957". 1957, June 5, P.L. 248, No. 125, § 1.

Historical Note

Title of Act:

An Act relating to the distribution, sale or transportation of deficient or misbranded insecticides, fungicides, rodenticides and other pesticides; regulating traffic therein; providing for registration and examination of such materials; and imposing penalties. 1957, June 5, P.L. 248, No. 125.

§ 111.2 Definitions

As used in this act—

(1) "Pesticide" means any substance or mixture of substances intended for preventing, destroying, repelling or mitigating any insects, rodents, fungi, weeds or other forms of plant or animal life or viruses, except viruses on or in living man or other animals which the secretary shall declare to be a pest.

(2) "Insecticide" means any substance or mixture of substances intended for preventing, destroying, repelling or mitigating any insects which may be present in any environment whatsoever.

(3) "Fungicide" means any substance or mixture of substances intended for preventing, destroying, repelling or mitigating any fungi.

(4) "Rodenticide" means any substance or mixture of substances intended for preventing, destroying, repelling or mitigating rodents or any other vertebrate animal which the secretary shall declare to be a pest.

(5) "Herbicide" means any substance or mixture of substances intended for preventing, destroying, repelling or mitigating any weed, and shall include defoliants, deflorants and those hormone-like substances which may be used to regulate the growth of plants.

(6) "Insect" means any of the numerous small invertebrate animals generally having the body more or less obviously segmented for the most part belonging to the class Insecta comprising six-legged usually winged forms as, for example, beetles, bugs, bees, flies and to other allied classes of arthropodes whose members are wingless and usually have more than six legs as, for example, spiders, mites, ticks, centipedes, wood lice and shall include nematodes.

(7) "Fungi" means all non-chlorophyll-bearing thallophytes (that is all non-chlorophyll-bearing plants of a lower order than mosses and liverworts) as, for example, rusts, smuts, mildews, molds, yeasts and bacteria, except those on or in living man or other animals.

(8) "Weed" means any plant which grows where not wanted.

(9) "Ingredient statement" means, either

(i) a statement of the name and percentage of each active ingredient together with the total percentage of the inert ingredients in a pesticide; or

(ii) a statement of the name of each active ingredient, together with the name of each and total percentage of the inert ingredients, if any, in the pesticide, except clause (i) shall apply if the preparation is for agricultural use or is highly toxic to man determined as provided in section 6 of this act, and in addition to clauses (i) and (ii), if the pesticide contains arsenic in any form, a statement of the percentages of total and water soluble arsenic each calculated as elemental arsenic.

(10) "Active ingredient" means an ingredient which will prevent, destroy, repel or mitigate insects, fungi, rodents, weeds or other pests.

(11) "Inert ingredient" means an ingredient which is not an active ingredient.

(12) "Antidote" means the most practical immediate treatment in case of poisoning and includes first aid treatment.

(13) "Person" means any individual, partnership, association, corporation or organized group of persons, whether incorporated or not.

(14) "Secretary" means the Secretary of Agriculture of the Commonwealth of Pennsylvania.

(15) "Registrant" means the person registering any pesticide pursuant to the provisions of this act.

(16) "Label" means the written, printed or graphic matter on or attached to the pesticide or the immediate container thereof and the outside container or wrapper of the retail package, if any, of the pesticide.

(17) "Labeling" means all labels and other written, printed or graphic matter:

(i) upon the pesticide or any of its containers or wrappers;

(ii) accompanying the pesticide at any time; and

(iii) to which reference is made on the label or in literature accompanying the pesticide, except when accurate non-misleading reference is made to current official publications of the United States Departments of Agriculture, Interior, Health, Education and Welfare, State Experiment Stations, State Agricultural Colleges or other similar Federal institutions or official agencies of this Commonwealth or other states authorized by law to conduct research in the field of pesticides.

(18) "Deficient" applies to any pesticide if its strength or purity falls below the professed standard or quality as expressed on labeling or under which it is sold, or if any substance has been substituted wholly or in part for the article, or if any valuable constituent of the article

has been wholly or in part abstracted. 1957, June 5, P.L. 248, No. 125, § 2.

Library references: Agriculture ⊂=9; C.J.S. Agriculture § 30 et seq.

Pharmacy Act

Section 2(13) of the Pharmacy Act of 1961 (section 390—2(13) of Title 63, Professions and Occupations) provides: "nor shall the word 'drug' include any article or mixture covered by the Pesticide Act of 1957."

Historical Note

Prior Law:

Act 1917, May 17, P.L. 224, §§ 4 and 5.
3 P.S. §§ 104 and 105.

§ 111.3 Misbranding

"Misbranded" shall apply—

(1) to any pesticide if its labeling bears any statement, design or graphic representation relative thereto or to its ingredients which is false or misleading in any particular;

(2) to any pesticide,

(i) if it is an imitation of or is offered for sale under the name of another pesticide;

(ii) if its labeling bears any reference to registration under this act;

(iii) if the labeling accompanying it does not contain instructions for use which are necessary and if complied with adequate for the protection of the public;

(iv) if the label does not contain a warning or caution statement which may be necessary and if complied with adequate to prevent injury to living man and other vertebrate animals;

(v) if the label does not bear an ingredient statement on that part of the immediate container and on the outside container or wrapper if there be one through which the ingredient statement on the immediate container cannot be clearly read of the retail package which is presented or displayed under customary conditions of purchase;

(vi) if any word, statement or other information required by or under the authority of this act to appear on the labeling is not prominently placed thereon with such conspicuousness (as compared with other words, statements, designs or graphic matter in the labeling) and in such terms as to render it likely to be read and understood by the ordinary individual under customary conditions of purchase and use; or

(vii) if in the case of an insecticide, fungicide or herbicide when used as directed or in accordance with commonly recognized practice, it shall be injurious to living man or other vertebrate animals or vegetation, except weeds, to which it is applied or to the person applying the pesticide. 1957, June 5, P.L. 248, No. 125, § 3.

Library references: Poisons ⚿3; C.J.S. Poisons § 4.

Historical Note

Prior Law:

Act 1917, May 17, P.L. 224, § 7.
3 P.S. § 108.

§ 111.4 Prohibited acts

(a) It shall be unlawful for any person to distribute, sell or offer for sale within this Commonwealth or deliver for transportation or transport in intrastate commerce or between points within this Commonwealth via any point outside this Commonwealth:

(1) Any pesticide which has not been registered pursuant to the provisions of section 5 of this act[1] or any pesticide, if any, of the claims made for it, or any of the directions for its use differ in substance from the representation made in connection with its registration, or if the composition of a pesticide differs from its composition as represented in connection with its registration. The secretary may permit a change in the labeling or formula of a pesticide within a registration period without requiring reregistration of the product.

(2) Any pesticide unless it is in the registrant's or the manufacturer's unbroken immediate container, and there is affixed to such container and to the outside container or wrapper of the retail package, if there be one through which the required information on the immediate container cannot be clearly read, a label bearing—

(i) the name and address of the manufacturer, registrant or person for whom manufactured;

(ii) the name, brand or trademark under which the article is sold; and

(iii) the net weight or measure of the content subject to such reasonable variations as the secretary may permit.

(3) Any pesticide which contains any substance or substances in quantities highly toxic to man determined as provided in section 6 of this act,[2] unless the label shall bear in addition to any other matter required by this act—

(i) the skull and crossbones;

(ii) the word "poison" prominently in red on a background of distinctly contrasting color; and

(iii) a statement of an antidote for the pesticide.

(4) Pesticides commonly known as standard lead arsenate, basic lead arsenate, calcium arsenate, magnesium arsenate, zinc arsenate, sodium fluoride, sodium fluosilicate, and barium fluosilicate unless they have been distinctly colored or discolored as provided by regulations issued in accordance with this act, or any other white powder pesticide which the secretary, after investigation of and after public hearing on the necessity for such action for the protection of the public health and the feasibility of such coloration or discoloration, shall, by regulation, require[3] to be distinctly colored or discolored unless it has been so colored or discolored. The secretary may exempt any pesticide to the extent that it is intended for a particular use or uses from the coloring or discoloring required or authorized by this section, if he determines that coloring or discoloring for such use or uses is not necessary for the protection of the public health.

(5) Any pesticide which is deficient or misbranded.

(b) It shall be unlawful—

(1) for any person to detach, alter, deface or destroy, in whole or in part, any label or labeling provided for in this act or regulations promulgated hereunder, or to add any substance to or take any substance from a pesticide in a manner that may defeat the purpose of this act.

(2) for any person to use for his own advantage or to reveal other than to the secretary or proper officials or employes of the Commonwealth or to the courts of this Commonwealth in response to a subpoena or to physicians or in emergencies to pharmacists and other qualified persons for use in the preparation of antidotes, any information relative to formulas of products acquired by authority of section 5 of this act. 1957, June 5, P.L. 248, No. 125, § 4.

[1] Section 111.5 of this title.

[2] Section 111.6 of this title.

[3] Enrolled bill read "required".

Historical Note

Prior Law:

Act 1917, May 17, P.L. 224, § 1.
3 P.S. § 101.

§ 111.5 Registration

(a) Every pesticide which is distributed, sold or offered for sale within this Commonwealth or delivered for transportation or transported in intrastate commerce or between points within this Commonwealth through any point outside this Commonwealth, shall be registered by the manufacturer or person for whom manufactured with the secretary, and such registration shall be renewed annually. The registrant shall file, with the secretary, a statement including

(1) The name and address of the registrant and the name and address of the person whose name will appear on the label if other than the registrant;

(2) The name of the pesticide;

(3) A complete copy of the labeling accompanying the pesticide and a statement of all claims to be made for it including directions for use; and

(4) If requested by the secretary, a full description ot the tests made and the results thereof upon which the claims are based. In the case of renewal of registration a statement shall be required only with respect to information which is different from that furnished when the pesticide was registered or last reregistered.

(b) Each pesticide shall be registered with the secretary before being offered for sale, sold or otherwise distributed in this Commonwealth. The application for registration shall be submitted to the secretary on forms which he shall supply, and shall be accompanied by a fee of seven dollars and fifty cents ($7.50) per brand, for the first ten brands registered and two dollars ($2) per brand for each brand registered in excess thereof. Upon approval by the secretary, a copy of the registration shall be furnished to the applicant. All registrations shall expire on the thirty-first day of December of each year. The registration fees and fines, when collected, shall be placed in the Feed and Fertilizer Fund to be administered by the secretary for the payment of the costs of inspection, sampling, analysis and other expenses necessary for the administration of this act.

(c) The secretary, whenever he deems it necessary in the administration of this act, may require the submission of the complete formula of any pesticide. If it appears to the secretary that the composition of the article is such as to warrant the proposed claims for it and if the article and its labeling and other material required to be submitted comply with the requirements of section 4 of this act,[1] he shall register the article.

(d) If it does not appear to the secretary that the article is such as to warrant the proposed claims for it or if the article and its labeling and other material required to be submitted do not comply with the provisions of this act, he shall notify the registrant of the manner in which the article labeling or other material required to be submitted fail to comply with the act so as to afford the registrant an opportunity to make the necessary corrections. If upon receipt of such notice, the registrant insists that the corrections are not necessary and requests, in writing, that the article be registered, the secretary shall register the article, under protest, and the registration shall be accompanied by a warning, in writing, to the registrant of the apparent failure of the article to comply with the provisions of this act. In order to protect the public, the secretary may, at any time, cancel the registration of a pesticide, and in lieu thereof issue a registration under protest in accordance with the foregoing procedure. In no event shall registration of an article, whether or not protested, be construed as a defense for the commission of any offense prohibited under section 4 of this act.

(e) Notwithstanding any other provision of this act, registration is not required in the case of a pesticide shipped from one plant within this Commonwealth to another plant within this Commonwealth operated by the same person.

(f) This act shall not apply to the transportation of pesticides by the ultimate consumer. 1957, June 5, P.L. 248, No. 125, § 5.

[1] Section 111.4 of this title.

Library references: Agriculture ⟹9; C.J.S. Agriculture § 30 et seq.

Historical Note

Prior Laws:

Act 1917, May 17, P.L. 224, § 5(a).
Act 1925, April 4, P.L. 136, § 2.
Act 1939, May 25, P.L. 221, § 1.
3 P.S. § 106.

§ 111.6 Determinations; rules; regulations; uniformity

(a) The secretary may, after opportunity for a hearing—

(1) Declare as a pest any form of plant or animal life or virus which is injurious to plants, men, domestic animals, articles or substances;

(2) Determine whether pesticides are highly toxic to man; and

(3) Determine standards of coloring or discoloring for pesticides and to subject pesticides to the requirements of section 4(a) (4) of this act.[1]

(b) The secretary may, after due public hearing, make rules and regulations for carrying out the provisions of this act, including rules and regulations providing for the collection and examination of samples of pesticides.

(c) In order to avoid confusion, endangering the public health, resulting from diverse requirements particularly as to the labeling and coloring of pesticides and to avoid increased costs to the people of this Commonwealth due to the necessity of complying with such diverse requirements in the manufacture and sale of such pesticides, it is desirable that there should be uniformity between the requirements of the several states and the Federal government relating to such pesticides. To this end the secretary may, after due public hearing, adopt rules and regulations applicable to and in conformity with the primary standards established by this act, which are prescribed in the United States Department of Agriculture with respect to pesticides. Such rules and regulations shall have the full force and effect of law as if they had been specifically enacted by the Legislature. 1957, June 5, P.L. 248, No. 125, § 6.

[1] Section 111.4 of this title.

Library references: Administrative Law and Procedure ⚿386; C.J.S. Public Administrative Bodies and Procedure § 94.

Historical Note

Prior Laws:

Act 1917, May 17, P.L. 224, § 3.
Act 1925, April 4, P.L. 136, § 1.
Act 1941, June 12, P.L. 124, No. 64, § 1.
3 P.S. § 103.

§ 111.7 Enforcement

(a) The examination of pesticides shall be made under the direction of the secretary for the purpose of determining whether they comply with the requirements of this act. If it appears from such examination that a pesticide fails to comply with the provisions of this act and the secretary contemplates instituting proceedings against any person, the secretary shall cause appropriate notice to be given to such person and to the registrant. Any person so notified shall be given an opportunity to present his views, either orally or in writing, with regard to such contemplated proceedings and, if thereafter in the opinion of the secretary, it appears that the provisions of the act have been violated by such person, the secretary shall institute such action as is hereinafter provided in the county in which the violation occurred. Nothing in this act shall be construed as requiring the secretary to report for prosecution or for the institution of libel proceedings minor violations of the act, whenever he believes that the public interests will be best served by a suitable notice of warning in writing.

(b) The secretary shall, by publication in such manner as he may prescribe, give public notice of all judgments entered in actions instituted under the authority of this act, and all registrations made under protest. 1957, June 5, P.L. 248, No. 125, § 7.

Library references: Agriculture ⚿9; C.J.S. Agriculture § 30 et seq.

§ 111.8 Exemptions

(a) The penalties provided for violations of section 4(a) of this act[1] shall not apply to—

(1) Any carrier while lawfully engaged in transporting a pesticide within this Commonwealth if such carrier shall, upon request, permit the secretary or his designated agent to copy all records showing the transactions in and movement of the articles.

(2) Public officials of this Commonwealth and the Federal government engaged in the performance of their official duties.

(3) The manufacturer or shipper of a pesticide for experimental use only:

(i) by or under the supervision of an agency of this Commonwealth or of the Federal government authorized by law to conduct research in the field of pesticide; or

(ii) by others if the pesticide is not sold and if the container thereof is plainly and conspicuously marked "For experimental use only. Not to be sold", together with the manufacturer's name and address. When a written permit has been obtained from the secretary, pesticides may be sold for experimental purposes subject to such restrictions and conditions as may be set forth in the permit.

(b) No article shall be deemed in violation of this act when intended solely for export to a foreign country and when prepared or packaged according to the specifications or directions of the purchaser. If not so exported, all the provisions of this act shall apply. 1957, June 5, P.L. 248, No. 125, § 8.

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[1] Section 111.4 of this title.

§ 111.9 Penalties

(a) Any person violating any of the provisions of this act or any rule, regulation or order made pursuant to this act shall, for the first or second offense, upon conviction thereof in a summary proceeding, be sentenced to pay a fine of not less than fifty dollars ($50) nor more than one hundred dollars ($100) and costs[1] of prosecution, and in default of payment thereof, shall be sentenced to undergo imprisonment for not more than thirty days, and for a third or subsequent offense shall be guilty of a misdemeanor, and shall, upon conviction thereof, be sentenced to pay a fine of not less than five hundred dollars ($500) nor more than one thousand dollars ($1000), or to undergo imprisonment not exceeding one year, or both. Any offense committed more than five years after a previous conviction shall be considered a first offense. In any case where a registrant was issued a warning by the secretary pursuant to the provisions of this act, the registrant shall, upon conviction of a violation of any provision of this act, other than section 4(a) (1),[2] be fined not more than one thousand dollars ($1000) or imprisoned for not more than one year, or both, and the registration of the article with reference to which the violation occurred shall terminate automatically. An article, the registration of which has been terminated, may not again be registered, unless the article, its labeling and other material required to be submitted, appear to the secretary to comply with all the requirements of this act.

(b) Notwithstanding any other provisions of this section, in case any person who, with intent to defraud, uses or reveals information relative to formulas of products acquired under authority of section 5 of this act,[3] upon conviction thereof in a summary proceeding, shall be fined not less than two hundred dollars ($200) nor more than five hundred dollars ($500), or imprisoned for not more than one year, or both. 1957, June 5, P.L. 248, No. 125, § 9.

[1] Enrolled bill read "cost".

[2] Section 111.4 of this title.

[3] Section 111.5 of this title.

Library references: Agriculture ⟹16; C.J.S. Agriculture § 5.

Historical Note

Prior Laws:

Act 1917, May 17, P.L. 224, § 9.
Act 1925, April 4, P.L. 136, § 3.
Act 1939, May 25, P.L. 221, § 2.
3 P.S. § 110.

§ 111.10 Seizures

(a) Any pesticide that is distributed, sold or offered for sale within this Commonwealth, or delivered for transportation or transported in intrastate commerce or between points within this Commonwealth through any point outside this Commonwealth, shall be liable to be proceeded against in any competent court in any county of the Commonwealth where it may be found and seized for confiscation by process of libel for condemnation:

(1) In the case of a pesticide—

(i) if it is deficient or misbranded;

(ii) if it has not been registered under the provisions of section 5 of this act;[1]

(iii) if it fails to bear on its label the information required by this act;

(iv) if it is a white powder pesticide and is not colored as required under this act.

(b) If the article is condemned, it shall, after entry of decree, be disposed of by destruction or sale as the court may direct, and the proceeds, if such article is sold less legal costs, shall be paid into the fund hereinbefore referred to in section 5(b) of this act. The article shall not be sold contrary to the provisions of this act. Upon payment of costs and execution and delivery of a good and sufficient bond conditioned that the article shall not be disposed of unlawfully, the court may direct that the article be delivered to the owner thereof for relabeling or reprocessing as the case may be.

(c) When a decree of condemnation is entered against the article, court costs and fees and storage and other proper expenses shall be awarded against the person, if any, intervening as claimant of the article. 1957, June 5, P.L. 248, No. 125, § 10.

[1] Section 111.5 of this title.

Library references: Forfeitures ⚿3; C.J.S. Forfeitures § 3 et seq.

Historical Note

Prior Laws:
Act 1917, May 17, P.L. 224, § 8.
Act 1941, June 12, P.L. 124, No. 64, § 2.
3 P.S. § 109.

§ 111.11 Delegation of duties

All authority vested in the secretary by virtue of the provisions of this act may, with like force and effect, be executed by duly authorized agents of the Department of Agriculture as the secretary may, from time to time, designate for said purpose. 1957, June 5, P.L. 248, No. 125, § 11.

§ 111.12 Cooperation

The Secretary is authorized and empowered to cooperate with, and enter into agreements with any other agency of this Commonwealth, the United States Department of Agriculture and any other State or agency thereof for the purpose of carrying out the provisions of this act and securing uniformity of regulations. 1957, June 5, P.L. 248, No. 125, § 12.

§ 111.13 Repealer; jurisdiction

The act of May 17, 1917 (P.L. 224), entitled "An act preventing the manufacture, sale, or transportation within the Commonwealth of adulterated or misbranded Paris greens, lead arsenates, lime-sulphur compounds, and other insecticides and fungicides, and regulating traffic therein; providing for inspection of such materials, and imposing penalties,"[1] is repealed. Jurisdiction in all matters pertaining to the distribution, sale and transportation of pesticides is, by this act, vested conclusively in the secretary, and all acts and parts of acts inconsistent with this act are hereby expressly repealed. 1957, June 5, P.L. 248, No. 125, § 13.

[1] Sections 101-110 of this title.

GROUND LIMESTONE AND RELATED PRODUCTS

§§ 121–127 Repealed. 1961, Aug. 8, P.L. 971, § 10

Historical Note

These sections, derived from the act of 1915, June 1, P.L. 678; and act of 1937, May 22, P.L. 894, § 1, related to pulverized limestone, lime, gypsum and related products. The subject matter is now covered by sections 131—1 to 131—9 of this title.

No. 262

AN ACT

HB 1584

Vesting authority in the Secretary of Agriculture to restrict or prohibit the use of certain herbicides causing damage to grape vines or grape crops, and authorizing the Department of Agriculture to establish regulations therefor and providing penalties.

The General Assembly of the Commonwealth of Pennsylvania hereby enacts as follows:

Section 1. Short Title.—This act shall be known and may be cited as the "Pennsylvania Grape Herbicides Act."

Section 2. Definitions.—As used in this act—

(1) "Secretary" means the Secretary of Agriculture of the Commonwealth.

(2) "Grape grower" means a producer of grapes for profit.

(3) "Grape vineyard" means lands upon which grapevines are maintained and harvested for profit.

(4) "Proximity" means a radial distance of two miles from the site of damage.

(5) "Development" means natural and normal growth before harvest.

(6) "Affected area" means the area defined in petition. The affected area may be altered by description in the order of the secretary, if the secretary finds that such alteration should be made to effectuate the purposes of the petition.

(7) "Major source of agricultural income" means that the producers of grapes within the affected area obtain at least ten percent of their gross farm income as a group in any five year period from the production of grapes.

(8) "Herbicide" means any agent used to destroy or inhibit plant growth.

Section 3. Petitions, Hearings and Orders.—(a) Authority is hereby vested in the secretary to administer and enforce the provisions of this act and orders issued pursuant thereto.

(b) Whenever the secretary receives a petition in a form prescribed by him, signed by at least five grape growers in the same township or contiguous townships in the Commonwealth, alleging that the use of herbicides, described in the petition in proximity to grape vineyards or crops of grapes described in the petition, has proved harmful to the development of grapevines or the grape crop in the affected area in the same or any prior year and asking that the use of such chemical substances be prohibited or restricted within the affected area, the secretary shall ascertain whether at least five of the signers of the petition are grape growers and owners of grape vineyards within the affected area. In counting the required number of petitioners, joint tenants or tenants by the entireties shall be counted as one signer.

(c) If the secretary determines that the petition is properly filed, the secretary or his agent shall hold a public hearing after giving at least ten days' notice of the time and place at which the hearing will be held which notice shall be given in a newspaper of general circulation in the area affected and by notice by mail to each named user of herbicides or his agent complained of within the affected area.

(d) If the secretary finds from testimony adduced that:

(1) There has been injury sustained to grapevines or grape crops

within affected area; and

(2) Injury was caused by use of herbicides described in petitions; and

(3) Use of herbicides was upon lands within affected area or in proximity to affected area; and

(4) The production of grapes constitutes a major source of agricultural income within affected area, the secretary shall (i) issue an order prohibiting or restricting the use of herbicides named in the petition or similarly dangerous herbicides within or in proximity of affected area for a period of time to be specified in the order unless such use is authorized by permit issued by the secretary; and (ii) provide that the order shall become effective upon publication in a newspaper having general circulation in affected area. Petitioners and each named user or his agent complained of within affected area shall be notified in writing by the secretary of the effective date of the order.

Section 4. Permits.—Upon written request, the secretary may issue a permit to use herbicides within or in the proximity of an area affected by an order issued pursuant to section 3, if he shall find that such use is reasonably necessary for its purpose, and the proposed manner of use will not be harmful to the grapevines or grape crops which the order is intended to protect. Every such permit shall prescribe the manner of use, either as proposed by the permittee or as the secretary may deem necessary to avoid harm to such grapevines or grape crops.

Section 5. Penalties.—Any person violating the prohibitions of this act or the manner of use prescribed in a permit is guilty of a misdemeanor and, upon conviction thereof, shall be sentenced to pay a fine not exceeding five hundred dollars ($500) or to imprisonment for not more than six months, or both.

Section 6. Effective Date.—This act shall take effect immediately.

APPROVED—The 10th day of September, A. D. 1965.

WILLIAM W. SCRANTON

No. 263

AN ACT

HB 436

Providing certain requirements for the commercial slaughtering of livestock; defining the humane methods that may be used; imposing powers and duties on the Secretary of Agriculture; and providing penalties.

The General Assembly of the Commonwealth of Pennsylvania hereby enacts as follows:

No. 251

AN ACT

SB 625

Providing for the entry of the Commonwealth into a compact with other states relating to pest control.

The General Assembly of the Commonwealth of Pennsylvania hereby enacts as follows:

Section 1. The Pest Control Compact is hereby enacted into law and entered into with all other jurisdictions legally joining therein in the form substantially as follows:

PEST CONTROL COMPACT

Article I

Findings

The party states find that:

(a) In the absence of the higher degree of cooperation among them possible under this compact, the annual loss of approximately seven billion dollars from the depredations of pests is virtually certain to continue, if not to increase.

(b) Because of varying climatic, geographic and economic factors, each state may be affected differently by particular species of pests; but all states share the inability to protect themselves fully against those pests which present serious dangers to them.

(c) The migratory character of pest infestations makes it necessary for states both adjacent to and distant from one another, to complement each other's activities when faced with conditions of infestation and reinfestation.

(d) While every state is seriously affected by a substantial number of pests, and every state is susceptible of infestation by many species of pests not now causing damage to its crop and plant life and products, the fact that relatively few species of pests present equal danger to or are of interest to all states makes the establishment and operation of an Insurance Fund, from which individual states may obtain financial support for pest control programs of benefit to them in other states and to which they may contribute in accordance with their relative interests, the most equitable means of financing cooperative pest eradication and control programs.

Article II
Definitions

As used in this compact, unless the context clearly requires a different construction:

(a) "State" means a state, territory or possession of the United States, the District of Columbia, and the Commonwealth of Puerto Rico.

(b) "Requesting state" means a state which invokes the procedures of the compact to secure the undertaking or intensification of measures of control or eradicate one or more pests within one or more other states.

(c) "Responding state" means a state requested to undertake or intensify the measures referred to in subdivision (b) of this article.

(d) "Pest" means any invertebrate animal, pathogen, parasitic plant or similar or allied organism which can cause disease or damage in any crops, trees, shrubs, grasses or other plants of substantial value.

(e) "Insurance Fund" means the Pest Control Insurance Fund established pursuant to this compact.

(f) "Governing Board" means the administrators of this compact representing all of the party states when such administrators are acting as a body in pursuance of authority, vested in them by this compact.

(g) "Executive Committee" means the committee established pursuant to Article V (e) of this compact.

Article III
The Insurance Fund

There is hereby established the Pest Control Insurance Fund for the purpose of financing other than normal pest control operations which states may be called upon to engage in pursuant to this compact. The Insurance Fund shall contain moneys appropriated to it by the party states and any donations and grants accepted by it. All appropriations, except as conditioned by the rights and obligations of party states expressly set forth in this compact, shall be unconditional and may not be restricted by the appropriating state to use in the control of any specified pest or pests. Donations and grants may be conditional or unconditional, provided that the Insurance Fund shall not accept any donation or grant whose terms are inconsistent with any provision of this compact.

Article IV
The Insurance Fund, Internal Operations and Management

(a) The Insurance Fund shall be administered by a Governing Board and Executive Committee as hereinafter provided. The actions of the Governing Board and Executive Committee pursuant to this compact shall be deemed the actions of the Insurance Fund.

(b) The members of the Governing Board shall be entitled to one vote each on such Board. No action of the Governing Board shall be binding unless taken at a meeting at which a majority of the total number of votes on the Governing Board are cast in favor thereof. Action of the Governing Board shall be only at a meeting at which a majority of the members are present.

(c) The Insurance Fund shall have a seal which may be employed as an official symbol and which may be affixed to documents and otherwise used as the Governing Board may provide.

(d) The Governing Board shall elect annually, from among its members, a chairman, a vice chairman, a secretary and a treasurer. The chairman may not succeed himself. The Governing Board may appoint an executive director and fix his duties and his compensation, if any. Such executive director shall serve at the pleasure of the Governing Board. The Governing Board shall make provision for the bonding of such of the officers and employees of the Insurance Fund as may be appropriate.

(e) Irrespective of the civil service, personnel or other merit system laws of any of the party states, the executive director, or if there be no executive director, the chairman, in accordance with such procedures as the bylaws may provide, shall appoint, remove or discharge such personnel as may be necessary for the performance of the functions of the Insurance Fund and shall fix the duties and compensation of such personnel. The Governing Board in its bylaws shall provide for the personnel policies and programs of the Insurance Fund.

(f) The Insurance Fund may borrow, accept or contract for the services of personnel from any state, the United States, or any other governmental agency, or from any person, firm, association or corporation.

(g) The Insurance Fund may accept for any of its purposes and functions under this compact any and all donations, and grants of money, equipment, supplies, materials and services, conditional or otherwise, from any state, the United States, or any other governmental agency, or from any person, firm, association or corporation, and may receive, utilize and dispose of the same. Any donation, gift or grant accepted by the Governing Board pursuant to this paragraph or services borrowed pursuant to paragraph (f) of this article shall be reported in the annual report of the Insurance Fund. Such report shall include the nature, amount and conditions, if any, of the donation, gift, grant or services borrowed and the identity of the donor or lender.

(h) The Governing Board shall adopt bylaws for the conduct of the business of the Insurance Fund and shall have the power to amend and rescind these bylaws. The Insurance Fund shall publish its bylaws in convenient form and shall file a copy thereof and a copy of any amendment thereto with the appropriate agency or officer in each of the party states.

(i) The Insurance Fund annually shall make to the Governor and legislature of each party state a report covering its activities for the preceding year. The Insurance Fund may make such additional reports as it may deem desirable.

(j) In addition to the powers and duties specifically authorized and imposed, the Insurance Fund may do such other things as are necessary and incidental to the conduct of its affairs pursuant to this compact.

Article V

Compact and Insurance Fund Administration

(a) In each party state there shall be a compact administrator, who shall be selected and serve in such manner as the laws of his state may provide, and who shall:

1. Assist in the coordination of activities pursuant to the compact in his state; and

2. Represent his state on the Governing Board of the Insurance Fund.

(b) If the laws of the United States specifically so provide, or if administrative provision is made therefor within the Federal government, the United States may be represented on the Governing Board of the Insurance Fund by not to exceed three representatives. Any such representative or representatives of the United States shall be appointed and serve in such manner as may be provided by or pursuant to Federal law, but no such representative shall have a vote on the Governing Board or on the Executive Committee thereof.

(c) The Governing Board shall meet at least once each year for the purpose of determining policies and procedures in the administration of the Insurance Fund and, consistent with the provisions of the compact, supervising and giving direction to the expenditure of moneys from the Insurance Fund. Additional meetings of the Governing Board shall be held on call of the chairman, the Executive Committee, or a majority of the membership of the Governing Board.

(d) At such times as it may be meeting, the Governing Board shall pass upon applications for assistance from the Insurance Fund and authorize disbursements therefrom. When the Governing Board is not in session, the Executive Committee thereof shall act as agent of the Governing Board, with full authority to act for it in passing upon such applications.

(e) The Executive Committee shall be composed of the chairman of the Governing Board and four additional members of the Governing Board chosen by it so that there shall be one member representing each of four geographic groupings of party states. The Governing Board shall make such geographic groupings. If there is representation of the United States on the Governing Board, one such representative may meet with the Executive Committee. The chairman of the Governing Board shall be chairman of the Executive Committee.

No action of the Executive Committee shall be binding unless taken at a meeting at which at least four members of such Committee are present and vote in favor thereof. Necessary expenses of each of the five members of the Executive Committee incurred in attending meetings of such Committee, when not held at the same time and place as a meeting of the Governing Board, shall be charges against the Insurance Fund.

Article VI

Assistance and Reimbursement

(a) Each party state pledges to each other party state that it will employ its best efforts to eradicate, or control within the strictest practicable limits, any and all pests. It is recognized that performance of this responsibility involves:

1. The maintenance of pest control and eradication activities of interstate significance by a party state at a level that would be reasonable for its own protection in the absence of this compact.

2. The meeting of emergency outbreaks or infestations of interstate significance to no less an extent than would have been done in the absence of this compact.

(b) Whenever a party state is threatened by a pest not present within its borders but present within another party state, or whenever a party state is undertaking or engaged in activities for the control or eradication of a pest or pests, and finds that such activities are or would be impracticable or substantially more difficult of success by reason of failure of another party state to cope with infestation or threatened infestation, that state may request the Governing Board to authorize expenditures from the Insurance Fund for eradication or control measures to be taken by one or more of such other party states at a level sufficient to prevent, or to reduce to the greatest practicable extent, infestation or reinfestation of the requesting state. Upon such authorization the responding state or states shall take or increase such eradication or control measures as may be warranted. A responding state shall use moneys made available from the Insurance Fund expeditiously and efficiently to assist in affording the protection requested.

(c) In order to apply for expenditures from the Insurance Fund, a requesting state shall submit the following in writing:

1. A detailed statement of the circumstances which occasion the request for the invoking of the compact.

2. Evidence that the pest on account of whose eradication or control assistance is requested constitutes a danger to an agricultural or forest crop, product, tree, shrub, grass or other plant having a substantial value to the requesting state.

3. A statement of the extent of the present and projected program of the requesting state and its subdivisions, including full information as to the legal authority for the conduct of such program or programs and the expenditures being made or budgeted therefor, in connection

with the eradication, control, or prevention of introduction of the pest concerned.

4. Proof that the expenditures being made or budgeted as detailed in item 3 do not constitute a reduction of the effort for the control or eradication of the pest concerned or, if there is a reduction, the reasons why the level of program detailed in item 3 constitutes a normal level of pest control activity.

5. A declaration as to whether, to the best of its knowledge and belief, the conditions which in its view occasion the invoking of the compact in the particular instance can be abated by a program undertaken with the aid of moneys from the Insurance Fund in one year or less, or whether the request is for an installment in a program which is likely to continue for a longer period of time.

6. Such other information as the Governing Board may require consistent with the provisions of this compact.

(d) The Governing Board or Executive Committee shall give due notice of any meeting at which an application for assistance from the Insurance Fund is to be considered. Such notice shall be given to the compact administrator of each party state and to such other officers and agencies as may be designated by the laws of the party states. The requesting state and any other party state shall be entitled to be represented and present evidence and argument at such meeting.

(e) Upon the submission as required by paragraph (c) of this article and such other information as it may have or acquire, and upon determining that an expenditure of funds is within the purposes of this compact and justified thereby, the Governing Board or Executive Committee shall authorize support of the program. The Governing Board or the Executive Committee may meet at any time or place for the purpose of receiving and considering an application. Any and all determinations of the Governing Board or Executive Committee, with respect to an application, together with the reasons therefor shall be recorded and subscribed in such manner as to show and preserve the votes of the individual members thereof.

(f) A requesting state which is dissatisfied with a determination of the Executive Committee shall upon notice in writing given within twenty days of the determination with which it is dissatisfied, be entitled to receive a review thereof at the next meeting of the Governing Board. Determinations of the Executive Committee shall be reviewable only by the Governing Board at one of its regular meetings, or at a special meeting held in such manner as the Governing Board may authorize.

(g) Responding states required to undertake or increase measures pursuant to this compact may receive moneys from the Insurance Fund, either at the time or times when such state incurs expenditures on account of such measures, or as reimbursement for expenses incurred and chargeable to the Insurance Fund. The Governing Board shall adopt and, from time to time, may amend or revise procedures for submission of claims upon it and for payment thereof.

(h) Before authorizing the expenditure of moneys from the Insurance Fund pursuant to an application of a requesting state, the Insurance Fund shall ascertain the extent and nature of any timely assistance or participation which may be available from the Federal government and shall request the appropriate agency or agencies of the Federal government for such assistance and participation.

(i) The Insurance Fund may negotiate and execute a memorandum of understanding or other appropriate instrument defining the extent and degree of assistance or participation between and among the Insurance Fund, cooperating Federal agencies, states and any other entities concerned.

Article VII
Advisory and Technical Committees

The Governing Board may establish advisory and technical committees composed of state, local, and Federal officials, and private persons to advise it with respect to any one or more of its functions. Any such advisory or technical committee, or any member or members thereof may meet with and participate in its deliberations. Upon request of the Governing Board or Executive Committee an advisory or technical committee may furnish information and recommendations with respect to any application for assistance from the Insurance Fund being considered by such Board or Committee and the Board or Committee may receive and consider the same: Provided, That any participant in a meeting of the Governing Board or Executive Committee held pursuant to Article VI (d) of the compact shall be entitled to know the substance of any such information and recommendations, at the time of the meeting if made prior thereto or as a part thereof or, if made thereafter, no later than the time at which the Governing Board or Executive Committee makes its disposition of the application.

Article VIII
Relations with Nonparty Jurisdictions

(a) A party state may make application for assistance from the Insurance Fund in respect of a pest in a nonparty state. Such application shall be considered and disposed of by the Governing Board or Executive Committee in the same manner as an application with respect to a pest within a party state, except as provided in this article.

(b) At or in connection with any meeting of the Governing Board or Executive Committee held pursuant to Article VI (d) of this compact a nonparty state shall be entitled to appear, participate, and receive information only to such extent as the Governing Board or Executive Committee may provide. A nonparty state shall not be entitled to review of any determination made by the Executive Committee.

(c) The Governing Board or Executive Committee shall authorize expenditures from the Insurance Fund to be made in a nonparty state only after determining that the conditions in such state and the value of such expenditures to the party states as a whole justify them. The

Governing Board or Executive Committee may set any conditions which it deems appropriate with respect to the expenditure of moneys from the Insurance Fund in a nonparty state and may enter into such agreement or agreements with nonparty states and other jurisdictions or entities as it may deem necessary or appropriate to protect the interests of the Insurance Fund with respect to expenditures and activities outside of party states.

Article IX
Finance

(a) The Insurance Fund shall submit to the executive head or designated officer or officers of each party state a budget for the Insurance Fund for such period as may be required by the laws of that party state for presentation to the legislature thereof.

(b) Each of the budgets shall contain specific recommendations of the amount or amounts to be appropriated by each of the party states. The requests for appropriations shall be apportioned among the party states as follows: one-tenth of the total budget in equal shares and the remainder in proportion to the value of agricultural and forest crops and products, excluding animals and animal products, produced in each party state. In determining the value of such crops and products the Insurance Fund may employ such source or sources of information as in its judgment present the most equitable and accurate comparisons among the party states. Each of the budgets and requests for appropriations shall indicate the source or sources used in obtaining information concerning value of products.

(c) The financial assets of the Insurance Fund shall be maintained in two accounts to be designated respectively as the "Operating Account" and the "Claims Account." The Operating Account shall consist only of those assets necessary for the administration of the Insurance Fund during the next ensuing two-year period. The Claims Account shall contain all moneys not included in the Operating Account and shall not exceed the amount reasonably estimated to be sufficient to pay all legitimate claims on the Insurance Fund for a period of three years. At any time when the Claims Account has reached its maximum limit or would reach its maximum limit by the addition of moneys requested for appropriation by the party states, the Governing Board shall reduce its budget requests on a pro rata basis in such manner as to keep the Claims Account within such maximum limit. Any moneys in the Claims Account by virtue of conditional donations, grants or gifts shall be included in calculations made pursuant to this paragraph only to the extent that such moneys are available to meet demands arising out of claims.

(d) The Insurance Fund shall not pledge the credit of any party state. The Insurance Fund may meet any of its obligations in whole or in part with moneys available to it under Article IV (g) of this compact, provided that the Governing Board takes specific action setting aside such moneys prior to incurring any obligation to be met in whole or in part in such manner. Except where the Insurance

Fund makes use of moneys available to it under Article IV (g) hereof, the Insurance Fund shall not incur any obligation prior to the allotment of moneys by the party states adequate to meet the same.

(e) The Insurance Fund shall keep accurate accounts of all receipts and disbursements. The receipts and disbursements of the Insurance Fund shall be subject to the audit and accounting procedures established under its bylaws. However, all receipts and disbursements of funds handled by the Insurance Fund shall be audited yearly by a certified or licensed public accountant and a report of the audit shall be included in and become part of the annual report of the Insurance Fund.

(f) The accounts of the Insurance Fund shall be open at any reasonable time for inspection by duly authorized officers of the party states and by any persons authorized by the Insurance Fund.

Article X
Entry Into Force and Withdrawal

(a) This compact shall enter into force when enacted into law by any five or more states. Thereafter, this compact shall become effective as to any other state upon its enactment thereof.

(b) Any party state may withdraw from this compact by enacting a statute repealing the same, but no such withdrawal shall take effect until two years after the executive head of the withdrawing state has given notice in writing of the withdrawal to the executive heads of all other party states. No withdrawal shall affect any liability already incurred by or chargeable to a party state prior to the time of such withdrawal.

Article XI
Construction and Severability

This compact shall be liberally construed so as to effectuate the purposes thereof. The provisions of this compact shall be severable and if any phrase, clause, sentence or provision of this compact is declared to be contrary to the constitution of any state or of the United States or the applicability thereof to any government, agency, person or circumstance is held invalid, the validity of the remainder of this compact and the applicability thereof to any government, agency, person or circumstance shall not be affected thereby. If this compact shall be held contrary to the constitution of any state participating herein, the compact shall remain in full force and effect as to the remaining party states and in full force and effect as to the state affected as to all severable matters.

Section 2. Consistent with law and within available appropriations, the departments, agencies and officers of this state may cooperate with the Insurance Fund established by the Pest Control Compact.

Section 3. Pursuant to Article IV (h) of the compact, copies of bylaws and amendments thereto shall be filed with the Department of Agriculture.

Section 4. The compact administrator for this State shall be the Secretary of Agriculture. The duties of the compact administrator shall be deemed a regular part of the duties of his office.

Section 5. Within the meaning of Article VI (b) or VIII (a), a request or application for assistance from the Insurance Fund may be made by the Governor whenever in his judgment the conditions qualifying this State for such assistance exist and it would be in the best interest of this State to make such request.

Section 6. The department, agency, or officer expending or becoming liable for an expenditure on account of a control or eradication program undertaken or intensified pursuant to the compact shall have credited to his account in the State Treasury the amount or amounts of any payments made to this State to defray the cost of such program, or any part thereof, or as reimbursement thereof.

Section 7. As used in the compact, with reference to this State, the term "executive head" shall mean the Governor.

Section 8. This act shall take effect immediately.

APPROVED—The 21st day of November, A. D. 1967.

RAYMOND P. SHAFER

No. 252

AN ACT

SB 1110

Amending the act of December 22, 1951 (P. L. 1726), entitled "An act relating to the loyalty to the United States and the Commonwealth of Pennsylvania of public officers and employes, including teachers and other employes of the public school system, and officers and employes of State-aided institutions of learning; requiring oaths or affirmations by applicants for public office or employment and by present appointed officers and employes; prohibiting appointment or employment and requiring discharges after hearing in certain cases; imposing conditions on the payment of appropriations to State-aided institutions of learning; requiring statements under oath or affirmation of candidates for elective public offices; and imposing duties on State and local appointing authorities and certain other State officers," further providing for excluding from the provisions of the act certain teachers who have declarations of intention to secure United States citizenship.

The General Assembly of the Commonwealth of Pennsylvania hereby enacts as follows:

Section 1. Subsection (c) of section 15, act of December 22, 1951 (P. L. 1726), known as the "Pennsylvania Loyalty Act," amended October 21, 1965 (P. L. 639), is amended to read:

Section 15. Effect and Applicability of Act.—* * *

(c) The provisions of this act shall not apply to teachers in the State colleges, who are citizens or subjects of the foreign governments and whose appointments to these positions shall be temporary, and shall not extend for a period of more than two (2) years, or who

MICHIGAN LAWS

The People of the State of Michigan enact:

§ 12.352(1) Short title.] SECTION 1. This act may be cited as "The insecticide, fungicide, and rodenticide act of 1949." (CL '48, § 286.161.)

Cross-reference.
Act regulating the application of economic poisons by aircraft or ground machinery, see § 12.353(1) et seq., infra.

Digest reference.
See Callaghan's Mich Dig, Agriculture, § 1 et seq.

§ 12.352(2) Definitions; application of terms "adulterated," "misbranded."] SEC. 2. For the purpose of this act:

a. ♦ "Economic poison" means any substance or mixture of substances intended for preventing, destroying, repelling or mitigating any insects, rodents, [nematodes,] fungi, weeds [and] other forms of plant or animal life or viruses, except viruses on or in living man or other vertebrate animals, which the director shall declare to be a pest[; and any substance or mixture of substances intended for use as a plant regulator, defoliant or desiccant].

b. ♦ "Device" means any instrument or contrivance intended for trapping, destroying, repelling or mitigating insects or rodents or destroying, repelling or mitigating fungi, [nematodes] or weeds, or such other pests as may be designated by the director, but not including equipment used for the application of economic poisons when sold separately therefrom.

c. ♦ "Insecticide" means any substance or mixture of substances intended for preventing, destroying, repelling or mitigating any insects which may be present in any environment whatsoever.

d. ♦ "Fungicide" means any substance or mixture of substances intended for preventing, destroying, repelling or mitigating any fungi.

e. ◆ "Rodenticide" means any substance or mixture of substances intended for preventing, destroying, repelling or mitigating rodents or any other vertebrate animal which the director shall declare to be a pest.

f. ◆ "Herbicide" means any substance or mixture of substances intended for preventing, destroying, repelling or mitigating any weed.

g. ◆ "Larvicide" means any substance or mixture of substances intended for preventing, destroying, repelling or mitigating any larvae which may be present in any environment whatsoever.

h. ◆ "Ovicide" means any susbtance [sic] or mixture of substances intended for preventing, destroying, repelling or mitigating any ova.

i. ["Nematocides" means any substance or mixture of substances intended for preventing, destroying, repelling or mitigating nematodes.]

j. ["Plant regulator" means any substance or mixture of substances intended through physiological action for accelerating or retarding the date of growth or rate of maturation, or for otherwise altering the behavior of ornamental or crop plants or the produce thereof, but shall not include substances to the extent that they are intended as plant nutrients, trace elements, nutritional chemicals, plant inoculants and soil amendments.]

k. ["Defoliant" means any substance or mixture of substances intended for causing the leaves or foliage to drop from a plant, with or without causing abscission.]

l. ["Desiccant" means any substance or mixture of substances intended for artificially accelerating the drying of plant tissue.]

m. ◆ "Insect" means any of the numerous small invertebrate animals generally having the body more or less obviously segmented, for the most part belonging to the class Insecta, comprising 6-legged, usually winged forms, as for example, beetles, bugs, bees, flies, including eggs, larvae and immature forms, and to other allied classes of arthropods whose members are wingless and usually have more than 6 legs, as for example, spiders, mites, ticks, centipedes and wood lice.

n. ["Nematode" means invertebrate animals of the phylum nemathelminthes and class nematoda, that is, unsegmented round worms with elongated, fusiform, or saclike bodies covered with cuticle, and inhabiting soil, water, plants or plant parts; may also be called nemas or eelworms.]

o. ◆ "Fungi" means all nonchlorophyll-bearing thallophytes that is, all nonchlorophyll-bearing plants of a lower order than mosses and liverworts, as for example, rusts, smuts, mildews, molds, yeasts and bacteria, except those on or in living man or other vertebrate animals.

p. ◆ "Weed" means any plant which grows where not wanted.

q. ◆ "Ingredient statement" means:

(1) A statement of the name and percentage of each active ingredient, together with the total percentage of the inert ingredients, in the economic poison.

(a) Or, in the case of "economic poison", household disinfectants or household germicides, for preventing, destroying, repelling or mitigating common household [illegible], a statement of the name of each active ingredient together with the name of each and total percentage of the inert ingredients, if any there be, in the economic poison (except option 1 shall apply if the preparation is highly toxic to man, determined as provided in section 6 of this act); and

(2) In case the economic poison contains arsenic in any form, a statement of the percentages of total and water soluble arsenic, each calculated as elemental arsenic.

r. ♦ "Active ingredient"[, other than a plant regulator, defoliant or desiccant], means an ingredient which will prevent, destroy, repel or mitigate insects, [nematodes], fungi, rodents, weeds or other pests.

[(1) In the case of a plant regulator, an ingredient which, through physiological action, will accelerate or retard the rate of growth or rate of maturation or otherwise alter the behavior of ornamental or crop plants or the produce thereof;

(2) In the case of a defoliant, an ingredient which will cause the leaves of foliage to drop from a plant;

(3) In the case of a desiccant, an ingredient which will artificially accelerate the drying of plant tissue.]

s. ♦ "Inert ingredient" means an ingredient which is not an active ingredient.

t. ♦ "Antidote" means a practical immediate treatment in case of poisoning and includes first aid treatment.

u. ♦ "Person" means any individual, partnership, association, corporation or organized group of persons whether incorporated or not.

v. ♦ "Director" means the director of the ♦ [state] department of agriculture.

[w.] ♦ "Registrant" means the person registering any economic poison pursuant to the provisions of this act.

[x.] ♦ "Label" means the written, printed or graphic matter on or attached to, the economic poison or device, or the immediate container thereof, and the outside container or wrapper of the retail package, if any there be, of the economic poison or device.

(1) ♦ "Labeling" means all labels and other written, printed or graphic matter—

[(a)] Upon the economic poison or device or any of its containers or wrappers;

[(b)] Accompanying the economic poison or device at any time;

[(c)] To which reference is made on the label or in literature accompanying the economic poison or device, except when accurate, nonmisleading reference is made to current official publications of the United States departments of agriculture or interior, the United States public health service, state experiment stations, state agricultural colleges or other similar federal institutions or official agencies of this state or other states authorized by law to conduct research in the field of economic poisons.

[y.] ♦ "Adulterated" shall apply to any economic poison if its strength or purity falls below the professed standard or quality as expressed on its labeling or under which it is sold, or if any substance has been substituted wholly or in part for the article, or if any valuable constituent of the article has been wholly or in part abstracted.

[z.] ♦ "Misbranded" shall apply—

(1) To any economic poison or device if its labeling bears any statement, design or graphic representation relative thereto or to its ingredients which is false or misleading in any particular;

(2) To any economic poison—

(a) If it is an imitation of or is offered for sale under the name of another economic poison;

(b) If its labeling bears any reference to registration under this act, except as provided in section [sic] 3, a., (6);

(c) If the labeling accompanying it does not contain instructions for use which are necessary and, if complied with, adequate for the protection of the public;

(d) If the label does not contain a warning or caution statement which may be necessary and, if complied with, adequate to prevent injury to living man and other vertebrate animals[, vegetation and useful invertebrate animals];

(e) If the label does not bear an ingredient statement on that part of the immediate container and on the outside container or wrapper, if there be one through which the ingredient statement on the immediate container cannot be clearly read, of the retail package which is presented or displayed under customary conditions of purchase;

(f) If any word, statement or other information required by or under the authority of this act to appear on the labeling is not prominently placed thereon with such conspicuousness (as compared with other words, statements, designs or graphic matter in the labeling) and in such terms as to render it likely to be read and understood by the ordinary individual under customary conditions of purchase and use; ◆

(g) If in the case of insecticide, [nematocide,] fungicide, herbicide, larvicide or ovicide, when used as directed or in accordance with commonly recognized practice, it shall be injurious to living man or other vertebrate animals or vegetation, except weeds, to which it is applied, or to the person applying such economic poison; [or

(h) If in the case of a plant regulator, defoliant or desiccant when used as directed it shall be injurious to living man or other vertebrate animals, or vegetation to which it is applied, or to the person applying such economic poison. Physical or physiological effects on plants or parts thereof shall not be deemed to be injury when this is the purpose for which the plant regulator, defoliant or desiccant was applied, in accordance with the label claims and recommendations.]

(CL '48, § 286.162.)

History.
As amended by Pub Acts 1961, No. 130, eff Sept 8.

Comparable provisions.
NY Agriculture and Markets Law, § 148 (similar); Wis Stats §§ 94.67, 94.675, 94.676.

Cross-reference.
Similar provision defining economic poison, see § 12.353(1), infra.

ALR note
Exterminator's liability for personal injury or death, 73 ALR2d 1155.

§ 12.352(3) Unlawful distribution, sale or transportation of certain economic poisons; detachment, alteration or destruction of label; adding to or taking substance from economic poison.] SEC. 3. a. It shall be unlawful for any person to distribute, sell, or offer for sale within this state or deliver for transportation or transport in intrastate commerce or between points within this state through any point outside this state any of the following:

(1) Any economic poison which has not been registered pursuant to the provisions of section 4 of this act, or any economic poison if any of the claims made for it or any of the directions for its use differ in substance from the representations made in connection with its registration, or if the composition of an economic poison differs from its composition as represented in connection with its registration: Provided, That in the discretion of the director, a change in the labeling or formula of an economic poison may be made within a registration period without requiring reregistration of the product.

(2) Any economic poison unless it is in the registrant's or the manufacturer's unbroken immediate container, and there is affixed to such container, and to the outside container or wrapper of the retail package, if there be one through which the required information on the immediate container cannot be clearly read, a label bearing:

(a) The name and address of the manufacturer, registrant, or person for whom manufactured;

(b) The name, brand, or trade mark under which said article is sold; and

(c) The net weight or measure of the content subject, however, to such reasonable variations as the director may permit.

(3) Any economic poison which contains any substance or substances in quantities highly toxic to man, determined as provided in section 6 of this act, unless the label shall bear, in addition to any other matter required by this act:

(a) The skull and cross bones;

(b) The word "poison" prominently, in red, on a background of distinctly contrasting color; and

(c) A statement of an antidote for the economic poison.

(4) The economic poisons commonly known as standard lead arsenate, basic lead arsenate, calcium arsenate, magnesium arsenate, zinc arsenate, zinc arsenite, sodium fluoride, sodium fluosilicate, and barium fluosilicate unless they have been distinctly colored or discolored as provided by regulations issued in accordance with this act, or any other white powder economic poison which the director, after investigation of and after public hearing on the necessity for such action for the protection of the public health and the feasibility of such coloration or discoloration, shall, by regulation, require to be distinctly colored or discolored, unless it has been so colored or discolored: Provided, That the director may exempt any economic poison to the extent that it is intended for a particular use or uses from the coloring or discoloring required or authorized by this section if he determines that such coloring or discoloring for such use or uses is not necessary for the protection of the public health.

(5) Any economic poison which is adulterated or misbranded, or any device which is misbranded.

(6) Any economic poison which has been registered under protest unless each package bears a label printed in bold face on a strongly contrasting background the words "WARNING: REGISTERED UNDER PROTEST IN MICHIGAN."

b. It shall be unlawful—

(1) For any person to detach, alter, deface, or destroy, in whole or in part, any label or labeling provided for in this act or regulations promulgated hereunder, or to add any substance to, or take any substance from, an economic poison in a manner that may defeat the purpose of this act.

(CL '48, § 286.163.)

Comparable provision.

NY Agriculture and Markets Law, § 149.

1-10. [Reserved for use in future supplementation.]

11. Duties of seller.

In action against druggist for damages for death of mink from flea poison packaged and sold by defendant, instruction on defendant's common law duty, as well as on his duty of care under economic poison act, was proper, in view of fact that breach of latter duty was alleged and not abandoned in pretrial or opening statement. Patrick v. Carrier-Stevens Co., 358 Mich 94.

ALR note.

Liability of manufacturer or seller for injury caused by animal feed or medicines, crop sprays, fertilizers, insecticides, rodenticides, and similar products, 81 ALR2d 138.

NCCA notes.

Landowner's liability for injury to another's livestock eating grass sprayed with poisonous chemicals, 28 NCCA3d 271.

§ 12.352(4) Registration of brands or poisons; fee; effect of payment by manufacturer or distributor; eligibility for registration; keeping of records and documents.] SEC. 4. Each ◆ manufacturer, importer, jobber, firm, association, corporation or person manufacturing, distributing or selling any economic poison as defined in section 2 ◆ shall pay to the director of agriculture on or before November 1, [1964], and annually thereafter, a registration fee of [$10.00] for each ◆ brand or separate economic poison sold, offered or exposed for sale, or distributed in this state ◆ [, except] that for each ◆ registration in excess of 10 in any year by the same person, the registration fee shall be [$4.00]. [Such] fees ◆ shall be paid into the state treasury and credited to the ◆ [general] fund ◆.

◆ [When any entity or person has paid such fee, no other entity or person shall be required to pay such fee upon such economic poison], nor is registration required in case of an economic poison shipped from one plant within this state to another plant within this state operated by the same person. ◆ The provision of this section requiring registration shall not apply to economic poisons that have been discontinued by manufacturers or to stocks of economic poison in the possession of dealers until 1 year after the effective date of this act. [Economic poisons registered by the United States Department of Agriculture under the provisions of the federal insecticide, fungicide and rodenticide act shall be eligible for registration in this state. A vendor of economic poisons shall keep on file, subject to inspection by any authorized agent of the director for a period of 1 year, all invoices, freight bills, truckers' receipts, way bills and similar shipping data pertaining to economic poisons that would establish date and origin of the shipments.]

(CL '48, § 286.164.)

History.

As amended by Pub Acts 1964, No. 258, eff Aug 28.

Comparable provision.

Wis Stats § 94.68.

§ 12.352(5) Cancellation of registration; lowering analysis or changing ingredients; appeal; failure of article to comply with act, notification of registrant; registration under protest, warning.] SEC. 5. Should any economic poison be registered in this state and it is afterward discovered that such registration is in violation of any of the provisions of this act, the said director shall have the power to cancel such registration. The director shall have the power to refuse to allow any manufacturer, importer, jobber, firm, association, corporation or person to lower the guaranteed analysis or change the active ingredients of any brand of his or their economic poison during the term for which registered unless reasons satisfactory to said director are presented for making such change or changes: Provided, That a person who has been denied a registration of an economic poison or whose registration has been cancelled may be granted an appeal hearing before the commission of agriculture, whose finding of fact shall be justification for sustaining or overruling of the director.

If it does not appear to the commission of agriculture that the article is such as to warrant the proposed claims for it or if the article and its labeling and other material required to be submitted do not comply with the provisions of this act, the director shall notify the registrant of the manner in which the article, labeling, or other material required to be submitted fails to comply with the act so as to afford the registrant an opportunity to make the corrections necessary. If, upon receipt of such notice, the registrant insists that such corrections are not necessary and requests in writing that it be registered, the director shall register the article, under protest, and such registration shall be accompanied by a warning, in writing, to the registrant of the apparent failure of the article to comply with the provisions of this act.

(CL '48, § 286.165.)

§ 12.352(6) Powers of director; rules and regulations.] SEC. 6. a. The director is authorized, after opportunity for a hearing

(1) To declare as a pest any form of plant or animal life or virus which is injurious to plants, men, domestic animals, articles, or substances;

(2) To determine whether economic poisons are highly toxic to man; and

(3) To determine standards of coloring or discoloring for economic poisons, and to subject economic poisons to the requirements of section 3a(4) of this act.

b. The director is authorized, after due public hearing, to make appropriate rules and regulations for carrying out the provisions of this act, including rules and regulations providing for the collection and examination of samples of economic poisons or devices. Rules and regulations promulgated under the provisions of this act shall be subject to the provisions of Act No. 88 of the Public Acts of 1943, as amended, being sections 24.71 to 24.82, inclusive, of the Compiled Laws of 1948.

(CL '48, § 286.166.)

Statutory reference.
Act 88, 1943, above referred to, is § 3.560(7) et seq., supra.

Comparable provisions.
NY Agriculture and Markets Law, § 150; Wis Stats § 94.69.

§ 12.352(7) Examination; notice, opportunity to be heard; reference of violations to prosecuting attorney, duty; notice of judgments entered.] Sec. 7. a. The examination of economic poisons or devices shall be made under the direction of the director for the purpose of determining whether they comply with the requirements of this act. If it shall appear from such examination that an economic poison or device fails to comply with the provisions of this act, and the director contemplates instituting criminal proceedings against any person, he shall cause appropriate notice to be given to such person. Any person so notified shall be given an opportunity to present his views, either orally or in writing, with regard to such contemplated proceedings and if, thereafter, in the opinion of the director it shall appear that the provisions of the act have been violated by such person, then the director shall refer the facts to the prosecuting attorney for the county in which the violation shall have occurred with a copy of the results of the analysis or the examination of such article.

b. It shall be the duty of each prosecuting attorney to whom any such violation is reported to cause appropriate proceedings to be instituted and prosecuted in the circuit court without delay.

c. The director shall, by publication in such manner as he may prescribe, give notice of all judgments entered in actions instituted under the authority of this act.

(CL '48, § 286.167.)

§ 12.352(8) Inapplicability of penalties; articles deemed not in violation of act.] Sec. 8. a. The penalties provided for violations of this act shall not apply to—

(1) Any carrier while lawfully engaged in transporting an economic poison within this state, if such carrier shall, upon request, permit the director or his designated agent to copy all records showing the transactions in and movement of the articles;

(2) Public officials of this state and the federal government engaged in the performance of their official duties;

(3) The manufacturer or shipper of an economic poison for experimental use only.

(a) By or under the supervision of an agency of this state or of the federal government authorized by law to conduct research in the field of economic poisons, or

(b) By others if the economic poison is not sold and if the container thereof is plainly and conspicuously marked "For experimental use only—Not to be sold," together with the manufacturer's name and address: Provided, however, That if a written permit has been obtained from the director, economic poisons may be sold for experimental purposes subject to such restrictions and conditions as may be set forth in the permit.

b. No article shall be deemed in violation of this act when intended solely for export to a foreign country, and when prepared or packed according to the specifications or directions of the purchaser. If not so exported all the provisions of this act shall apply. (CL '48, § 286.168.)

Comparable provisions.
NY Agriculture and Markets Law, § 151-a (practically the same); Wis Stats § 94.70, subd (2).

§ 12.352(9) Violation of act, penalty; minor violations.] Sec. 9. Any manufacturer, importer, jobber, firm, association, corporation, or person, who shall sell, offer, or expose for sale, or distribute in this state, or who shall take or receive from any firm, association, corporation, or person in this state any order for the sale of any economic poison or device as defined in section 2 of this act, or who shall directly or indirectly contract with any manufacturer, importer, jobber, firm, association, corporation, or person in this state for the sale of such economic poison or device to be delivered in this state by common carrier or otherwise, which has not been registered as required by the provisions of this act, or without complying with the labeling requirements of this act or who shall impede, obstruct, or hinder such director or his authorized agents in the performance of his or their duty in connection with the provisions of this act, or who shall violate any of the rules or regulations promulgated by the director as provided herein, shall be deemed guilty of a violation of the provisions of this act and, upon conviction thereof, shall be sentenced to pay a fine of not more than $200.00, or to imprisonment of not more than 60 days in the county jail, or both such fine and imprisonment in the discretion of the court: Provided, however, That nothing in this act shall be construed as requiring the director to report for prosecution or for the institution of libel proceedings, minor violations of the act whenever he believes that the public interest will be best served by a suitable notice of warning in writing. (CL '48, § 286.169.)

§ 12.352(10) Seizure of poisons, etc.; analysis; libel proceedings, procedure, forfeiture to state, appeal; proceeds of sale, disposition; delivery to owner for relabeling or reprocessing, bond; duty of prosecuting attorney.] Sec. 10. The director, his deputy, or any person by said director duly appointed for that purpose, is authorized at all times to seize and take possession of any and all economic poisons or devices, substitutes therefor, or imitations thereof, kept for sale, exposed for sale, distributed, or held in possession or under the control of any person, which are contrary to the provisions of this act.

1. The person so making such seizures as aforesaid, shall take from such goods as seized a sample for the purpose of analysis and shall cause the remainder thereof to be boxed and sealed and shall leave the same in the possession of the person from whom they were seized, subject to such disposition as shall hereafter be made thereof according to the provisions of this act.

2. The person so making such seizure shall forward the sample so taken to the chief chemist of the department of agriculture for anal-

ysis, who shall make an analysis of the same and shall certify the results of such analysis, which certificate shall be prima facie evidence of the fact or facts therein certified to in any court where the same may be offered in evidence.

3. If upon such analysis it shall appear that said economic poison or device is adulterated, misbranded, a substitute or imitation within the meaning of this act, said director, or his deputy or any person by him duly authorized, may make complaint before any justice of the peace or police justice having jurisdiction in the city, village, or township where such goods were seized, and thereupon said justice of the peace shall issue his summons to the person from whom said goods were seized, directing him to appear not less than 6 nor more than 12 days from the date of the issuing of said summons and show cause why said goods should not be condemned and disposed of. If the said person from whom said goods were seized cannot be found said summons shall be served upon the person then in possession of the goods. The said summons shall be served at least 6 days before the time of appearance mentioned therein. If the person from whom said goods were seized cannot be found, and no one can be found in possession of said goods, and the defendant shall not appear on the return day, the said justice of the peace shall proceed in said cause in the same manner provided by law where a writ of attachment is returned not personally served upon any of the defendants and none of the defendants shall appear upon the return day.

4. Unless cause to the contrary thereof is shown, or if said goods shall be found upon trial to be in violation of any of the provisions of this act or other laws which now exist or which may be hereafter enacted, it shall be the duty of said justice of the peace or police justice to render judgment that said seized property be forfeited to the state of Michigan, and that the said goods be destroyed or sold by the said director for any purpose other than to be used for economic poisons or devices. The mode of procedure before said justice shall be the same, as near as may be, as in civil proceedings before justices of the peace. Either parties may appeal to the circuit court as appeals are taken from justices' courts, but it shall not be necessary for the people to give any appeal bond.

5. The proceeds arising from any such sale shall be paid into the state treasury and credited to the general fund: Provided, That if the owner or party claiming the property or goods so declared forfeited can produce and prove a written guarantee of purity, signed by the wholesaler, jobber, manufacturer or other party from whom said articles were purchased, then the proceeds of the sale of such articles, over and above the cost of seizure, forfeiture, and sale, shall be paid over to such owner or claimant to reimburse him, to the extent of such surplus, for his actual loss resulting from such seizure and forfeiture, as shown by the invoice: And provided, further, That upon payment of costs and execution and delivery of a good and sufficient bond conditioned that the article shall not be disposed of unlawfully, the court may direct that said article be delivered to the owner thereof for relabeling or reprocessing as the case may be.

6. It shall be the duty of each prosecuting attorney when called upon by said director or by any person by him authorized as aforesaid, to render any legal assistance in his power in proceedings under the provisions of this act, or any subsequent act, relative to the adul-

teration, misbranding, substituting, imitating or selling economic poisons or devices.
(CL '48, § 286.170.)

Cross-references.
Proceedings in attachment in justice court, see § 27A.7419, infra; civil procedure in justice court, § 27A.6601 et seq., infra; appeal to circuit court, § 27A.7701, et seq., infra.

§ 12.352(11) Execution of authority vested in director.] SEC. 11. All authority vested in the director by virtue of the provisions of this act may with like force and effect be executed by such employees of the department of agriculture as the director may from time to time designate for said purpose. (CL '48, § 286.171.)

§ 12.352(12) Cooperation with U. S. department of agriculture and other agencies.] SEC. 12. The director is authorized and empowered to cooperate with, and enter into agreements with, any other agency of this state, the United States department of agriculture, and any other state or agency thereof for the purpose of carrying out the provisions of this act and securing uniformity of regulations. (CL '48, § 286.172.)

§ 12.352(13) Jurisdiction vested in department of agriculture; repeal.] SEC. 13. Jurisdiction in all matters pertaining to the distribution, sale and transportation of economic poisons and devices is by this act vested exclusively in the department of agriculture and all acts and parts of acts inconsistent with this act are hereby expressly repealed. Act No. 254 of the Public Acts of 1913, being sections 286.151 through 286.160 of the Compiled Laws of 1948, is hereby repealed. (CL '48, § 286.173.)

Statutory reference.
Act No. 254 of 1913, above referred to, was §§ 12.341–12.350.

REGULATION OF APPLICATION OF ECONOMIC POISONS

Act 233, 1959, p 338; eff March 19, 1960

(Title as amended by Pub Acts 1966, No. 120, imd eff June 23.)

AN ACT to prevent the destruction or damage of agricultural crops, growing plants, livestock or wildlife from the application of any economic poison, pesticide, insecticide, herbicide, fungicide, rodenticide; to provide for the ◆ [licensing of persons engaged in the business of applying] economic poisons [out of doors] and imposing penalties for violations; to provide for the collection of ◆ licensing fees ◆; and to prescribe the powers and duties of certain officers.

The People of the State of Michigan enact:

§ 12.353(1) Definitions.] SECTION 1. As used in this act:
(a) "Equipment" means any mechanical device, system, apparatus, or method utilized in the application of economic poisons out of doors.

(b) "Economic poison" means any substance or mixture of substances, by whatever term designated, intended for preventing, destroying, repelling or mitigating any insects, rodents, fungi, weeds or other forms of plant or animal life or viruses, except virus on or in living man or other vertebrate animals, which the director of agriculture shall declare to be a pest.

(c) "Director" means the director of agriculture.

(CL '48, § 286.411.)

Cross-reference.
Similar provision defining economic poison, see § 12.352(2), supra.

§ 12.353(2) Exceptions to application of act.] Sec. 2. This act shall not apply to persons applying economic poisons on their own premises, or to the employees of such persons on such premises; or to persons who make occasional applications of such poisons on the premises of another, but who do not hold themselves out as engaged in the business of applying economic poisons; or to farmers who are trading work with other farmers; or to municipalities, road commissions, or state or federal agencies. (CL '48, § 286.412.)

§ 12.353(3) License to apply economic poisons; application, contents.] Sec. 3. No person subject to this act shall operate equipment without first obtaining from the director a license for such operation. Application for a license shall be filed with the director on blanks furnished by him. The application shall state the name and permanent address of the applicant; his knowledge of the effects of economic poisons upon agricultural crops, growing plants, livestock and wild life when misapplied; his knowledge of proper dosing of economic poisons to accomplish the control or eradication of pests; his knowledge of the susceptibility of economic poisons to wind drift and air currents; his experience in the application of economic poisons; the type of equipment to be used by the applicant in the application of economic poisons; his knowledge of the use of such equipment; damage suits resulting in judgment against him, if any, arising out of his application of economic poisons, which judgments have not been satisfied; and other information deemed to be pertinent by the director, which shall be requested on the application form. (CL '48, § 286.413.)

1-10. [Reserved for use in future supplementation.]

11. Necessity for license.
Person or firm making applications of economic poisons on exterior of buildings for purpose of controlling pests inside of buildings must obtain license under this act. Op Atty Gen, Aug 2, 1960, No. 3520.

§ 12.353(4) Same; fees, disposition; expiration; renewal.] Sec. 4. Every application for license, whether for an initial license or annual renewal, shall be accompanied by a fee of $10.00. All fees shall be deposited in the state treasury to the credit of the general fund. If the license is not issued or renewed, the fee shall be retained by the state as payment for the reasonable expense of processing the application. Licenses shall expire on December 31 following their issuance, but may be renewed annually upon qualifying and payment of the annual fee of $10.00. (CL '48, § 286.414.)

§ 12.353(5) Same; issuance; refusal to issue, grounds; bond.] Sec. 5. If the director shall find from examination of the application that the applicant is qualified for license he shall issue such license. If the license application discloses unsatisfied judgments against the applicant, the director may require a sufficient bond of the applicant conditioned upon the payment of further judgments against him, or the director may refuse to issue a license or annual renewal thereof because of such unsatisfied judgments. The director may refuse to issue a license or annual renewal thereof if the equipment to be used by the licensee is unsafe or inadequate to accomplish the proper application of the economic poisons to be used. The director may refuse to issue a license if the applicant discloses an insufficient knowledge of any item called for in the application. Denial of a license shall be treated as a contested case under the provisions of Act No. 197 of the Public Acts of 1952, as amended. (CL '48, § 286.415.)

Statutory reference.
Act 197, 1952, above referred to, is
§ 3.560(21.1) et seq., supra.

§ 12.353(6) Administrative rules.] Sec. 6. The director may promulgate administrative rules pursuant to the provisions of Act No. 88 of the Public Acts of 1943, as amended, defining safe and adequate equipment for the application of the several economic poisons; defining wind and weather conditions when certain economic poisons shall not be applied; and defining the method of handling certain economic poisons for the safety of the operator. (CL '48, § 286.416.)

Statutory reference.
Act 88, 1943, above referred to, is
§ 3.560(7) et seq., supra.

§ 12.353(7) Responsibility for damages.] Sec. 7. Registration with the director of agriculture shall not exonerate the owner and operator of the equipment from responsibility for damage resulting from over-dosing, drifting or misapplication of control chemicals. (CL '48, § 286.417.)

§ 12.353(8) Taking samples; inspecting equipment; order to cease use, noncompliance, rescission.] Sec. 8. The director of agriculture or his designated employees may enter upon premises where a licensee is operating and take samples of economic poisons or mixtures being used by the licensee; and may inspect equipment or methods of application used by the licensee and make recommendations therefor. [Whenever the director of agriculture or any of his designated employees shall have reason to believe that a licensee is using or intending to use economic poisons in an unsafe or inadequate manner, the director or his designated employee shall order the licensee to cease the use of or refrain from the intended use of such economic poisons, mixtures, equipment or methods. The order may be either oral or written and shall inform the licensee of the reason therefor.

Upon the receipt of the order, the licensee shall immediately comply therewith. Failure to comply constitutes cause for revocation of the license and subjects the licensee to the penalty imposed under section 10 of this act.

The director of agriculture shall rescind the order immediately upon being satisfied after inspection that the reason therefor does not or no longer exists. The inspection shall be conducted as soon as possible at the request of the licensee, which request may be either oral or written. The rescinding order of the director may be oral and the licensee may rely thereon. However, an oral order shall be followed by a written rescinding order.]

(CL '48, § 286.418.)

History.
As amended by Pub Acts 1966, No. 120, imd eff June 23.

§ 12.353(9) Advisory committee on economic poisons; members.] Sec. 9. There is hereby created an advisory committee on economic poisons to consult with and aid the director in the administration of this act. The committee shall be composed of the director of conservation, the state commissioner of health, the director of aeronautics and the executive secretary of the water resources commission. Members of the committee may designate an employee to represent them on the committee. (CL '48, § 286.419.)

§ 12.353(10) Violation, penalty.] Sec. 10. Any person subject to license under this act who operates equipment without such license is guilty of a misdemeanor. (CL '48, § 286.420.)

affected area, the director shall ascertain whether at least 10 of the signers of the petition are grape growers and owners of grape vineyards within the affected area. In counting the required number of petitioners, joint tenants or tenants by the entireties shall be counted as 1 signer. (CL '48, § 286.402.)

History.
As amended by Pub Acts 1963, No: 70, eff Sept 6.

§ 12.366(3) Public hearing; notice; proof of notice.] Sec. 3. If the director determines that the petition is properly filed, he shall hold a public hearing after giving at least 10 days' notice of the time and place at which the hearing will be held by posting in at least 5 of the most public places within the affected area, and by notice by mail to each of the petitioners and to each manufacturer, supplier and dealer furnishing the chemical substance complained of within the affected area, so far as is known to the director, after diligent inquiry. Proof of notice shall be evidenced by affidavit of the director appended to the minutes of the hearing at which the petition is considered. (CL '48, § 286.403.)

§ 12.366(4) Order prohibiting or restricting use of chemicals; findings required.] Sec. 4. If the director finds, from testimony adduced, that:

(a) There has been actual damage to grapevines or grape crops within the affected area; and

(b) Such damage was caused by the use of the chemical substance complained of in the petition, and by that cause alone; and

(c) Such use was upon lands within the affected area or in proximity to the affected area, or upon the damaged crop itself; and

(d) The commercial production of grapes within the affected area constitutes a major source of agricultural income within the affected area; then the director may issue his order prohibiting or restricting the use of 2,4-D (2,4-Dichlorolphenoxyacetic acid), 2,4-5-T ([2,4-5-] Trichlorophenoxyacetic acid) or MCP (2 Methyl, 4 Chlorophenoxyacetic acid) within or in proximity to the affected area ◆ [during the period from May 1 to October 1. The order shall continue in effect from year to year unless modified or rescinded by the director. Not later than March 15 of each year, the director shall give notice of the order by publication in a newspaper of general circulation in the area affected. The notice shall state the terms of the order in general language and that the order will continue in effect for the ensuing period of May 1 to October 1, unless a petition for modification or recision of the order, signed by 10 or more grape growers or 50 or more persons not grape growers in the affected area, is filed with the directors on or before April 1. If a request for modification or recision is received, the director shall hold a hearing after giving notice as provided in section 3. After the hearing, the director shall make such findings as the evidence adduced justifies and may continue, modify or rescind the order. If the director modifies or rescinds the order, he shall give notice of his action as provided in section 4]. All restrictions upon the use of 2,4-D (2,4-Dichlorolphenoxyacetic acid), 2,4-5-T ([2,4-5-] Trichlorophenoxyacetic acid) or

The People of the State of Michigan enact:

§ 12.366(1) Definitions.] SECTION 1. As used in this act:

(a) "Grape grower" means a producer of grapes for profit.

(b) "Grape vineyard" means lands upon which grapevines are maintained and harvested for profit.

(c) "Townships" means government survey townships, and need not be in the same county.

(d) "Proximity" means a radial distance of 2 miles from the site of damage.

(e) "Development" means natural and normal growth before harvest.

(f) "Affected area" means the area defined in the petition. The affected area may be altered by description in the order of the director, if the director finds that such alteration should be made to effectuate the purposes of the petition.

(g) "Major source of agricultural income" means that the producers of grapes within the affected area obtain at least 10% of their gross income as a group in any 5-year period from the production of grapes.

(h) "Director" means the director of the state department of agriculture.

(CL '48, § 286.401.)

§ 12.366(2) Petition; prohibition of restriction of use of harmful chemical substances; number of petitioners.] SEC. 2. Whenever the director receives a petition in a form prescribed by him, signed by 10 or more grape growers in the same or contiguous townships in this state, alleging that the use of 2,4-D (2,4-Dichlorolphenoxyacetic acid), 2-4-5-T ([2,4-5-] Trichlorophenoxyacetic acid) or MCP (2 Methyl, 4 Chlorophenoxyacetic acid) in proximity to grape vineyards or crops of grapes described in the petition has proved harmful to the development of grapevines or the grape crop in the affected area in the same or any prior year and asking that the use of such chemical substances be prohibited or restricted within the

MCP (2 Methyl, 4 Chlorophenoxyacetic acid) within or in proximity to the affected area shall be set forth in the order with particularity. (CL '48, § 286.404.)

History.
As amended by Pub Acts 1963, No. 70, eff Sept 6.

§ 12.366(5) Orders effective upon posting; publication in administrative code.] Sec. 5. All orders shall be effective upon posting the same prominently in at least 5 of the most public places within the affected area. They shall be published in the administrative code, provided for in Act No. 88 of the Public Acts of 1943, as amended, being sections 24.71 to 24.82 of the Compiled Laws of 1948, but publication within the quarterly supplement to the administrative code shall not be a condition precedent to their effectiveness. (CL '48, § 286.405.)

Statutory reference.
Act No. 88 of 1943, above referred to is §§ 3.560(7)–3.560(16), infra.

§ 12.366(6) Violation of order; penalty.] Sec. 6. Any person who uses 2,4-D (2,4-Dichlorolphenoxyacetic acid), 2,4-5-T ([2,4-5-] Trichlorophenoxyacetic acid) or MCP (2 Methyl. 4 Chlorophenoxyacetic acid) within or in proximity to an affected area, in violation of an order of the director prohibiting or restricting such use, [is] guilty of a misdemeanor. (CL '48, § 286.406.)

History.
As amended by Pub Acts 1963, No. 70, eff Sept 6.

TEXAS LAWS

* * * * * * * * * * *

Prohibited Acts

Sec. 3. A. It shall be unlawful for any person to distribute, sell, or offer for sale within this State or deliver for transportation or transport in intrastate commerce or between points within this State through any point outside this State any of the following:

(1) Any economic pesticide which has not been registered pursuant to the provisions of Section 4 of this Act, or any economic pesticide if any of the claims made for it or any of the directions for its use differ in substance from the representations made in connection with its registration, or if the composition of an economic pesticide differs from its composition as represented in connection with its registration. Provided, that, in the discretion of the Commissioner, a change in the labeling or formula of an economic pesticide may be made within a registration period if the economic pesticide is registered in conformity with the requirements of this Act for other economic pesticides.

(2) Any economic pesticide unless it is in the registrant's or the manufacturer's unbroken immediate container, and there is affixed to such container, and to the outside container or wrapper of the retail package, if there be one through which the required information on the immediate container cannot be clearly read, a label bearing:

(a) The name and address of the manufacturer, registrant, or person for whom manufactured;

(b) The name, brand, or trademark under which said article is sold; and

(c) The net weight or measure of the contents of the container, subject, however, to such reasonable variations as the Commissioner may permit after he consults with the advisory group provided for in Section

5B of this Act. Provided, that in the case of a tank truck used merely to deliver an economic pesticide to the user when the truck does not remain in the user's hands, an invoice with the required labeling information left with the purchaser at the time of delivery of the economic pesticide is permissible in lieu of a label being affixed to the tank.

(d) The ingredient statement as provided for in Section 2C of this Act.

(e) Numbers or other symbols which would identify the lot and batch number of the manufacture of the contents of the package.

(3) Any economic pesticide which contains any substance or substances in quantities highly toxic to man, determined as provided in Section 5 of this Act, unless the label shall bear, in addition to any other matter required by this Act:

(a) The skull and crossbones,

(b) The word "poison" prominently, in red, on a background of distinctly contrasting color; and

(c) A statement of an antidote for the economic pesticide.

(4) Any economic pesticide that is not distinctly colored or discolored in accordance with such rules and regulations as the Commissioner shall issue pursuant to this Act.

(5) Any economic pesticide which is adulterated or misbranded, or any device which is misbranded.

B. It shall be unlawful:

(1) For any person to detach, alter, deface, or destroy, in whole or in part, any label or labeling provided for in this Act or regulations promulgated hereunder, or to add any substance to, or take any substance from, an economic pesticide in a manner that may defeat the purpose of this Act;

(2) For any person to use for his own advantage or to reveal, other than to the Commissioner or proper officials or employees of the State or to the courts of this State in response to a subpoena, or to physicians, or in emergencies to pharmacists and other qualified persons, for use in the preparation of antidotes, any information relative to formulas of products acquired by authority of Section 4 of this Act.

(3) For any person to sell custom mixes without the identification of the purchaser and without an ingredient statement attached as required elsewhere in this Act and so labeled as soon as formulated. The labeling shall be marked with indelible pen or stamp only and may be sold only to those persons whose name appears on the container and shall not be placed on the shelf for resale.

Sec. 3, subsecs. A, B amended by Acts 1971, 62nd Leg., p. 1244, ch. 308, §§ 1, 2, eff. May 24, 1971

Registration

Sec. 4.

* * * * * * * * * * *

B. The registrant shall pay the Commissioner an annual registration of Thirty Dollars ($30.00) for each economic pesticide registered provided that:

(1) All registration fees collected by the Commissioner under this Act shall be paid into the State Treasury by the Commissioner and placed by the State Treasurer in the Special Department of Agriculture Fund, and shall be used only for administrative and enforcement purposes of this Act;

(2) Any registrant who is located outside the State of Texas but who distributes economic pesticides in the State of Texas shall deposit with the Commissioner an instrument in writing appointing a resident agent

within this State upon whom service may be had in actions filed by the State or taken by the Commissioner in the administration or enforcement of this Act.

(3) The Commissioner is authorized to cancel all registrations of any registrant who fails to comply with the requirements of this Act.

* * * * * * * * * * *

D. The Commissioner may, after notice and hearing, cancel the registration of, or refuse to register any economic pesticide:

(1) Which has demonstrated serious uncontrollable adverse effects, either within or outside the agricultural environment.

(2) The use of which is of less public value or greater detriment to the environment than the benefits received by its use; or

(3) Which, even when properly used, is detrimental to vegetation, except weeds, to domestic animals, to the public health and safety, or

(4) Concerning which any false or misleading statement is made or implied by the registrant or his agent, either verbally or in writing, or in the form of any advertising literature; or

(5) When any registrant of a chemical or pesticide fails to comply with the requirements of the Act or any rule or regulation adopted by the Commissioner.

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Sec. 4, subsec. B amended by Acts 1971, 62nd Leg., p. 1245, ch. 308, § 3, eff. May 24; Subsec. D amended by Acts 1971, 62nd Leg., p. 1246, ch 308, § 4, eff. May 24, 1971.

Pesticide advisory committee

Sec. 4a. There is hereby established a pesticide advisory committee composed of the Deans of Agriculture, Texas A & M University, and Texas Tech University, Executive Director of Texas Parks and Wildlife Department, Texas Commissioner of Health, and Texas Commissioner of Agriculture or their designated representatives. The duties of this committee are to advise with the Commissioner of Agriculture to the extent necessary to protect property, animal life and the public health and welfare by recommendation of the best use of pesticides. The Committee would be empowered to call on all State universities and State agencies as well as outside consultants retained by the State entities to assist in developing recommendations to the Commissioner of Agriculture regarding the feasibility of any pesticide program or other such matters which are submitted to them by the Commissioner of Agriculture.

Sec. 4a added by Acts 1971. 62nd Leg., p. 1246, ch. 308, § 6, eff. May 24, 1971.

Determinations; rules and regulations; uniformity

Sec. 5.

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D. The Commissioner shall furnish upon request a consolidated annual report of the official economic pesticide sample results. The contents of the report are to be determined in a manner which the Commissioner finds most expedient.

Sec. 5, subsec. D amended by Acts 1971, 62nd Leg., p. 1246, ch. 308, § 5, eff. May 24, 1971.

Enforcement

Sec. 6. A. The Commissioner shall have authority to enter into any building or place owned, controlled or operated by a registrant or dealer where from probable cause it appears that said building or place contains economic pesticides for the purpose of inspection or sampling, and shall have the power to take a sample for official analysis from any package or lot of economic pesticides, including custom mixes, found

within this State. The Commissioner shall have the power to issue and enforce a written or printed "stop-sale" order to the owner or custodian of any economic pesticide which he has reason to believe is in violation of any of the provisions of this Act prohibiting further sale of such economic pesticide until he has evidence that the law has been complied with. Provided, that in respect to the economic pesticide which has been denied sale as provided in this paragraph, the owner or custodian of such economic pesticide shall have the right to appeal from such order to a court of competent jurisdiction where the economic pesticide is found, praying for a judgment as to the justification of said order and the discharge of such economic pesticide from the order prohibiting the sale in accordance with the findings of the court; and provided further, that the provisions of this paragraph shall not be construed as limiting the right of the Commissioner to proceed as authorized by other sections of this Act.

B. In addition to the remedies herein provided, the Commissioner is hereby authorized to institute an action in his own name to enjoin any violation of any provision of this Act.

C. The Commissioner is authorized to contract with State colleges, State agencies or commercial laboratories for examination of economic pesticides provided that such contracts to commercial laboratories are let on a competitive bid basis.

D. The Commissioner shall make or provide for service sample tests of economic pesticides on request, and after consulting with the advisory group as provided for in Section 5B of this Act, he shall fix and collect charges for each service sample on a cost basis.

Sec. 6 amended by Acts 1971, 62nd Leg., p. 1247, ch. 308, § 7, eff. May 24, 1971.

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Cross References

Hazardous substances, labeling and sale, see Vernon's Ann.P.C. art. 726-3.

Law Review Commentaries

Pesticide pollution. 48 Texas L.Rev. 1130 (1970).

Supplementary Index to Notes

Liability for injuries 4
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Library references

Agriculture ⟹2, 9.
C.J.S. Agriculture §§ 6, 30 et seq.

3. Warning to users

Exact wording used in suggested label statements with respect to warning, caution and antidote statements required to appear on labels of economic poisons is not essential; the substance is required. Muncey v. Magnolia Chemical Co. (Civ.App.1968) 437 S.W.2d 15, ref. n. r. e.

Manufacturer of insecticide which was produced for purpose of killing livestock pests and which had been sprayed on employee while he was moving cattle from pens in order for them to be sprayed for lice had duty to warn users of the inherently dangerous product. Id.

Adequacy of warning, which appeared on label of insecticide manufactured for purpose of killing livestock pests, which consisted of word "warning", in bold letters, preceding cautionary statement declaring product toxic; stating that it could be absorbed through skin in dry form and from solutions, which cautioned to avoid inhaling mists from sprays and getting it in the eyes; to avoid unnecessary skin contact; to keep clothing free from residue was for trier of fact in action by cattle feed lot employee who was sprayed with insecticide by fellow employee. Id.

4. Liability for injuries

Failure to comply with minimum statutory standards with respect to warning, caution and antidote statements required to appear on label of economic poisons constitutes negligence per se. Muncey v. Magnolia Chemical Co. (Civ.App.1968) 437 S.W.2d 15, ref. n. r. e.

Mere fact of compliance with minimum statutory standards with respect to warning, caution and antidote statements required to appear on label of economic poisons, does not relieve manufacturer or seller from negligence as a matter of law. Id.

Manufacturer of toxic product which was produced for purpose of killing livestock pests and which had been sprayed on employee by coemployee while employee was moving cattle in order for them to be sprayed for lice could not avoid liability for injury caused by the product on ground that neither employer nor coemployee had read label containing allegedly inadequate warning. Id.

5. Review

For purpose of determining required warning, reviewing court would assume that insecticide which was manufactured for purpose of killing livestock pests and which had been sprayed on workman contained ingredients and proportions as stated on the label where there was no evidence of analysis of product or tests which had been conducted. Muncey v. Magnolia Chemical Co. (Civ.App.1968) 437 S.W.2d 15, ref. n. r. e.

Art. 135b—6. Structural Pest Control Act

Citation of Act

Section 1. This Act may be cited as the Texas Structural Pest Control Act.

Definitions

Sec. 2. (a) For purposes of this Act a person shall be deemed to be engaged in the business of structural pest control if he engages in, offers to engage in, advertises for, solicits, or performs any of the following services for compensation:

(1) identifying infestations or making inspections for the purpose of identifying or attempting to identify infestations of arthropods (insects, spiders, mites, ticks, and related pests), wood-infesting organisms, rodents, weeds, nuisance birds, and any other obnoxious or undesirable animals which may infest households, railroad cars, ships, docks, trucks, airplanes, or other structures, or the contents thereof, or the immediate adjacent outside areas;

(2) making inspection reports, recommendations, estimates, or bids, whether oral or written, with respect to such infestations;

(3) making contracts, or submitting bids for, or performing services designed to prevent, control, or eliminate such infestations by the use of insecticides, pesticides, rodenticides, fumigants, or allied chemicals or substances or mechanical devices.

(b) As used in this Act, "person" means an individual, firm, partnership, corporation, association, or other organization, or any combination thereof, or any type of business entity.

Board; members; chairman; bylaws; expenses; executive director

Sec. 3. (a) The Texas Structural Pest Control Board is created. The board is composed of seven members, four of whom shall be appointed by the Governor with the advice and consent of the Senate for terms of two years. To be eligible for appointment, a person must have been engaged in the business of structural pest control for at least five years. No two members shall be representatives of the same business entity. In addition to the appointed members, the board also consists of the Commissioner of Agriculture, the Commissioner of Health, and the chairman of the Department of Entomology at Texas A&M University, or their designated representatives, who shall serve in ex officio capacity.

(b) The board shall elect a chairman from its appointed members and shall adopt bylaws governing the conduct of the board's affairs.

(c) Members serve without compensation but are entitled to reimbursement for actual expenses incurred in carrying on the work of the board.

(d) The board shall appoint an executive director who shall administer the provisions of this Act and the rules and regulations promulgated by the board. The executive director shall receive a salary as determined by the board which shall be paid from funds available to the board.

Licensing standards; rules and regulations

Sec. 4. (a) The board shall develop standards and criteria for licensing persons engaged in the business of structural pest control. The board may require applicants to pass an examination demonstrating their competence in the field in order to qualify for a license.

(b) The board shall promulgate rules and regulations governing the methods and practices of structural pest control when it determines that the public's health and welfare necessitates such regulations in order to prevent adverse effects on human life and the environment. The rules and regulations relating to the use of economic poisons shall comply with applicable federal standards governing the use of such substances.

Temporary license

Sec. 5. (a) Except as provided in Subsection (b), no person shall engage in the business of structural pest control after the effective date of this Act unless he meets the standards set by the board and possesses a valid license issued by the board.

(b) A person who has engaged in the business of structural pest control for a period of two years next preceding the effective date of this Act may apply to the board within 90 days after the effective date of this Act and shall be issued a temporary license which shall be valid for a period not to exceed two years upon payment of the required fee and completion of a temporary licensing form as prescribed by the board without further qualifications or examination. All applicants under this subsection shall furnish evidence substantiating their eligibility before a temporary license may be granted.

Application forms; expiration and renewal; nontransferability

Sec. 6. (a) All applications for licenses shall be made on forms prescribed and provided by the board, and each applicant shall furnish such information as the board may require for its determination of the applicant's qualifications.

(b) All licenses issued by the board shall expire on March 1 of each calendar year and may be renewed by submitting an application to the board and paying the required renewal fees.

(c) A license issued by the board is not transferable.

Fees

Sec. 7. (a) An applicant for an initial or renewal license shall accompany his application with a fee of $50 for each place of business located in the State and a fee of between $5 and $15, as determined by the board, for each employee of the applicant who is engaged in structural pest control services. This is not to apply to those locations serving only as answering services for a licensed business.

(b) A licensee whose license has been lost or destroyed shall be issued a duplicate license after application therefor and the payment of a fee of $10.

Disposition of fees

Sec. 8. The proceeds from the collection of the fees provided in this Act shall be deposited in a special fund in the State Treasury to be known as the Structural Pest Control Fund, and shall be used for the administration and enforcement of the provisions of this Act. No expense incurred in implementing the provisions of this Act shall ever be a charge against the general revenue funds of the State of Texas. Any balance in the special fund at the end of each State fiscal biennium in excess of appropriations out of that fund for the succeeding biennium shall be transferred to the general revenue fund. All money deposited in the Structural Pest Control Fund is hereby appropriated to the board for the purpose of carrying out the provisions of this Act for the fiscal biennium ending August 31, 1973.

License suspension, revocation and refusal; appeal

Sec. 9. (a) The board, after notice and a hearing, may suspend or revoke a license, refuse to examine an applicant, refuse to issue a license, or refuse to renew a license when it finds that the applicant or licensee has substantially failed to comply with the standards and rules and regulations established by the board.

(b) An applicant or licensee may appeal from an order of the board by an action in the district court in which he resides or in the district court of Travis County, and the trial shall be de novo as in the case of an appeal from a justice court to a county court.

Injunction

Sec. 10. The board may request the Attorney General to bring suit to enjoin a person from engaging in the business of structural pest control without a license.

Exceptions

Sec. 11. The provisions of this Act shall not apply to nor shall the following persons be deemed to be engaging in the business of structural pest control:

(1) an officer or employee of a governmental or educational agency who performs pest control services as part of his duties of employment;

(2) a person or his regular employee who performs pest control work upon property which he owns, leases, or rents;

(3) an employee of a person licensed to engage in the business of structural pest control; and

(4) a person or his employee who is engaged in the business of agriculture or aerial application or custom application of pesticides to agricultural lands.

Severability

Sec. 12. If any provision of this Act or the application thereof to any person or circumstances is held invalid, such invalidity shall not affect other provisions or applications of the Act which can be given effect without the invalid provision or application, and to this end the provisions of this Act are declared to be severable.

Acts 1971, 62nd Leg., p. 2363, ch. 726, eff. Aug. 30, 1971.

Title of Act:

An Act relating to the creation of the Structural Pest Control Board and providing for the licensing and regulation of persons engaged in the business of structural pest control; providing for severability; and declaring an emergency. Acts 1971, 62nd Leg., p. 2363, ch. 726.

Law Review Commentaries

Pesticide pollution. 48 Texas L.Rev. 1130 (1970).

ORDINANCE NO. 1498

AN ORDINANCE TO LICENSE AND REGULATE PEST CONTROL OPERATORS IN THE CITY OF GRAND PRAIRIE; MAKING IT UNLAWFUL TO ENGAGE IN THE BUSINESS OF PEST CONTROL WITHOUT OBTAINING A LICENSE FROM THE CITY OF GRAND PRAIRIE; ESTABLISHING REQUIREMENTS FOR OBTAINING A PEST CONTROL OPERATOR'S LICENSE; PROVIDING FOR PAYMENT OF A LICENSE FEE; EXCEPTING CERTAIN PERSONS OR FIRMS FROM THE OPERATION HEREOF; PROVIDING FOR THE REVOCATION OF SUCH LICENSE, AND FOR AN APPEAL FROM SUCH REVOCATION; PROVIDING THAT PEST CONTROL OPERATORS IN THE CITY SHALL COMPLY WITH THIS ORDINANCE WITHIN SIXTY (60) DAYS FROM ITS ENACTMENT; PROVIDING A PENALTY FOR VIOLATION HEREOF; DECLARING THE PROVISIONS CONTAINED HEREIN TO BE SEVERABLE; PROVIDING FOR PUBLICATION; AND PROVIDING THAT THIS ORDINANCE SHALL TAKE EFFECT FROM AND AFTER FIVE (5) DAYS AFTER SUCH PUBLICATION.

BE IT ORDAINED BY THE CITY COMMISSION OF THE CITY OF GRAND PRAIRIE, TEXAS:

SECTION 1

IT SHALL HEREAFTER BE UNLAWFUL FOR ANY PERSON, FIRM, OR CORPORATION TO ENGAGE IN THE BUSINESS OF "PEST CONTROL OPERATOR" AS THAT TERM IS HEREINAFTER DEFINED, WITHOUT HAVING A VALID AND UNEXPIRED LICENSE TO DO SO ISSUED UNDER THE TERMS OF THIS ORDINANCE.

SECTION 2

DEFINITIONS

(A) "PEST CONTROL OPERATOR" SHALL MEAN ANY PERSON, PARTNERSHIP, CORPORATION, FIRM, OR ASSOCIATION THAT ENGAGES IN OR CONTROLS THE BUSINESS OF USING OR EMPLOYING INSECTICIDES, RODENTICIDES, FUMIGANTS, FUNGICIDES, OR OTHER SUBSTANCES FOR THE CONTROL OR DESTRUCTION OF INSECTS. VERMIN. RODENTS, TERMITES, FUNGI OR OTHER SIMILAR PESTS IN BUILDING, DWELLING HOUSES, AND ABOUT THE GROUNDS IMMEDIATELY ADJACENT TO BUILDINGS AND DWELLING HOUSES.

(B) "APPLICANT" SHALL MEAN ANY PERSON, PARTNERSHIP, CORPORATION, FIRM, OR ASSOCIATION THAT APPLIES TO THE CITY OF GRAND PRAIRIE FOR A PEST CONTROL CONTRACTOR'S LICENSE OR A PEST CONTROL OPERATOR'S LICENSE.

(C) "SERVICE EMPLOYEE" SHALL MEAN ANY PERSON WHO ACTUALLY PERFORMS UNDER THE SUPERVISION AND CONTROL OF A LICENSED PEST CONTROL OPERATOR THE SERVICE OF APPLYING INSECTICIDES, RODENTICIDES, FUMIGANTS, AND FUNGICIDES AT THE RESIDENCE OR PLACE OF BUSINESS OF A CUSTOMER, AND WHO IS A BONA FIDE EMPLOYEE OF SUCH PEST CONTROL OPERATOR OR CONTRACTOR.

(D) "LICENSEE" SHALL MEAN ANY PERSON, PARTNERSHIP, CORPORATION, FIRM, OR ASSOCIATION THAT HOLDS A VALID PEST CONTROL OPERATOR'S OR PEST CONTROL CONTRACTOR'S LICENSE ISSUED BY THE CITY OF GRAND PRAIRIE UNDER THIS ORDINANCE.

(E) "BONA FIDE EMPLOYEE" OR "EMPLOYEE" SHALL MEAN ANY PERSON WHO WORKS FOR A SALARY OR WAGES IN THE SERVICE OF A LICENSED PEST CONTROL OPERATOR OR CONTRACTOR AND WHOSE PHYSICAL CONDUCT IN THE PERFORMANCE OF HIS SERVICES IS CONTROLLED BY THE PEST CONTROL OPERATOR.

(F) "INSECTICIDES" SHALL MEAN ANY SUBSTANCE USED FOR THE DESTRUCTION OR CONTROL OF INSECTS OR SIMILAR PESTS WHICH IS NOT A FUMIGANT.

(G) "RODENTICIDE" SHALL MEAN ANY SUBSTANCE USED FOR THE DESTRUCTION OR CONTROL OF RODENTS WHICH IS NOT A FUMIGANT.

(H) "FUMIGANT" SHALL MEAN ANY SUBSTANCE WHICH BY ITSELF OR IN COMBINATION WITH ANY OTHER SUBSTANCE EMITS OR MAY BE MADE TO EMIT GASSES, FUMES, OR VAPORS. DANGEROUS OR INJURIOUS TO HUMAN BEINGS, WHICH IS USED FOR THE PURPOSES OF CONTROLLING THE INCREASE OF OR DESTROYING INSECTS, RODENTS, VERMIN, OR ANY OTHER SIMILAR PESTS.

(i) "Fungicide" shall mean any substance that destroys fungi or inhibits the growth of the spores or hypha.

SECTION 3

APPLICATION FOR LICENSE - PEST CONTROL OPERATOR

Any individual desiring to work as a pest control operator shall file with the Director of Public Health of the City of Grand Prairie a written application for a license. Such application shall state the name, age, and address of the applicant, and shall contain a statement that the provisions of this ordinance have been read by the applicant and that he agrees to comply with all provisions contained herein and with all ordinances of the City of Grand Prairie pertaining to pest control. The following qualifications and conditions shall apply to pest control operators and the issuance of licenses to such operators in the City of Grand Prairie.

(A) Applicant shall have, before license will be issued, and maintain, for so long as he holds a license, a policy of public liability insurance covering property damage of $50,000.00 dollars and personal injury of $100,000.00 dollars written by an insurance company authorized to do business in the State of Texas, in a form satisfactory to the City of Grand Prairie. Before license will be issued, applicant will furnish the City Health Officer a certificate of insurance showing that insurance as herein provided is in force, such certificate shall provide that advance written notification of ten (10) days will be given to the City of Grand Prairie in the event the insurance carrier desires to cancel the policy evidenced by such certificate.

(B) Applicant shall have, before license is issued, a surety bond, executed by applicant as principal and a corporate surety company as surety, in the amount of $1,000.00 dollars and approved by the City Attorney as to form, conditioned upon the faithful performance by applicant of all contracts entered into by him as a pest control operator in the City of Grand Prairie; provided, however, that it shall be deemed sufficient that such bond shall declare itself effective as to each such contract only for a period of one (1) year from the date the work connected with each such contract is completed. Such bond shall be filed with the City Health Officer and shall provide that it may be cancelled only upon ten (10) days written notice to the City.

(C) Applicant shall have an established and permanent business address and telephone number in the County of Dallas or Tarrant.

(D) Each applicant shall state whether or not he, or any partnership in which he has been a partner, or any corporation in which he has been an officer or director, has ever been refused a license to operate as a pest control operator or has had a license revoked or suspended by any state or local government. Full details of any such refusal or revocation or suspension of license must be given.

(E) Applicants for a license as a pest control operator shall file with the application an affidavit setting forth the names of the person or persons who are owners of the business or who are the officers of the firm, and the name and address of the person who shall be responsible for the business in the City of Grand Prairie as well as the name of the person who shall have general supervision of the business in the City. Notice in writing of any change in such ownership, persons or operators shall be given the City of Grand Prairie within five (5) days after such change.

(F) Such permit shall not be transferable.

(G) Each application shall include a signed and sealed certificate of a notary public, or other officer authorized by law to administer oaths, certifying that applicant personally appeared before such officer, and after being duly sworn, applicant declared that he signed such application, and that the statements contained therein are true.

SECTION 4

ISSUANCE OF LICENSE - EXPIRATION AND RENEWAL - FEES

Upon determining that the applicant meets the requirements of this ordinance, the Director of Public Health shall so notify the Director of the Department of Revenue and Taxation who shall issue the appropriate license upon receipt of $10.00 dollars in payment of the cost of administration hereof. Each license shall be effective for one (1) year from the date of issue. Any licensee holding a license which has not been revoked, or is not under suspension, may obtain a renewed license each year by making application as provided above and upon payment of $10.00 dollars as a renewal fee.

SECTION 5

EXCEPTIONS

The use of insectidices, rodenticides, fumigants, fungicides, or other substances for the control or destruction of insects, vermin, rodents, termites or other similar pests by persons, association, or corporation not having a license shall not be in violation of this ordinance if such use is one that is set out in (1) through (3) as follows:

(1) By a service employee, as herein defined, doing work under the direction and supervision of his employer who is a licensee, as herein defined;

(2) By an agency of the Federal Government, State of Texas, County of Dallas and Tarrant, or the City of Grand Prairie, engaged in any work of rodent or insect control or extermination, or any person employed in any such agency or by such governments when such work is being done by such employee as a part of his duties as an employee of such agency or governments. This exemption shall not extend to any work done by any employee of such agency or government separate and apart from his official duties or employment;

(3) By any person in a building or on premises owned or occupied by him as his home or business.

SECTION 6

REVOCATION OF LICENSE

Any license may be declared revoked or suspended by the Director of Public Health of the City of Grand Prairie upon the finding by the Director of Public Health of the City of Grand Prairie:

(A) Of a violation on the part of the licensee or any ordinance, rule, or regulation of the City of Grand Prairie governing the use of insecticide, rodenticides, fumigants, fungicides, or similar substances; or

(B) For failure of the license holder to pay the license fee or renewal fee; or

(C) For failure of licensee to provide sufficient financial responsibility as provided in Section 3 of this Ordinance; or

(D) For failure to pay a fine assessed under any Ordinance by the Corporation court of Grand Prairie within ten (10) days after said judgment of conviction becomes final; or

(E) Upon conviction of licensee of a crime or offense of the grade of felon or any offense involving moral turpitude; or

PRAIRIE, PROOF OF SUCH PUBLICATION TO BE MADE BY AN AFFIDAVIT DULY EXECUTED BY THE PUBLISHER OF SAID NEWSPAPER AND FILED WITH THE CITY SECRETARY, AND SHALL TAKE EFFECT AND BE IN FORCE FROM AND AFTER FIVE (5) DAYS AFTER PUBLICATION HEREOF.

PASSED AND APPROVED BY THE CITY COMMISSION OF THE CITY OF GRAND PRAIRIE, TEXAS, THIS THE 13TH DAY OF NOVEMBER, A. D. 1962.

s/ C. P. WAGGONER
MAYOR, CITY OF GRAND PRAIRIE, TEXAS

ATTEST:

S/ HELDA FLAGG
CITY SECRETARY

APPROVED AS TO FORM:

S/ JERRY D. BROWNLOW
CITY ATTORNEY

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